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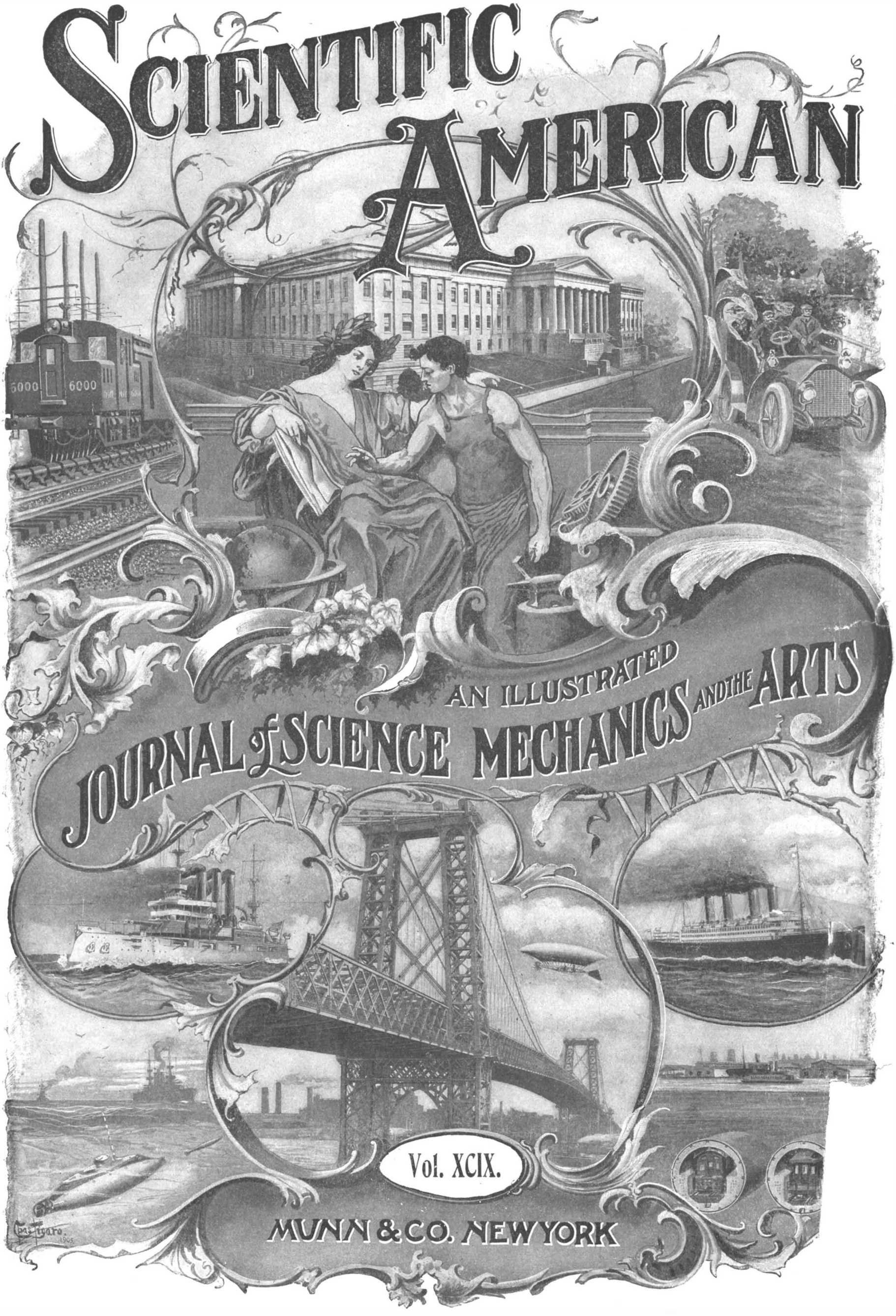

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Vol. XCIX.

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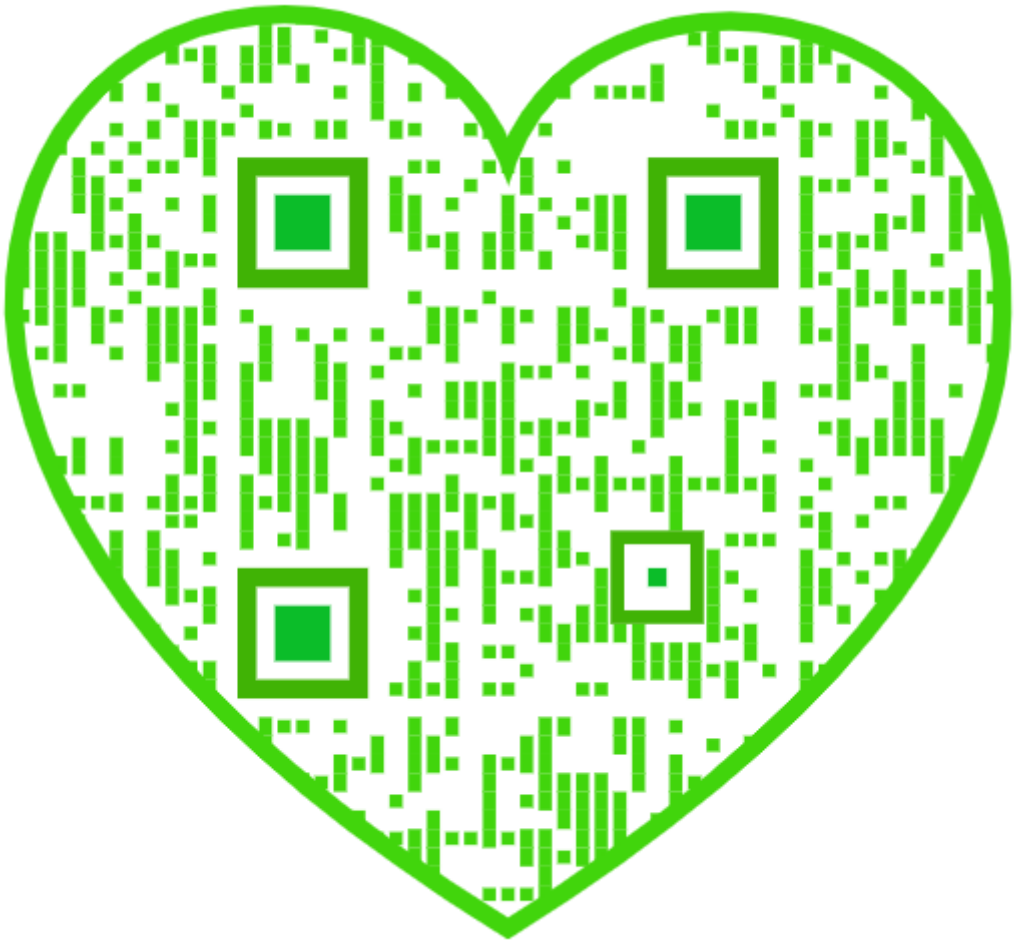

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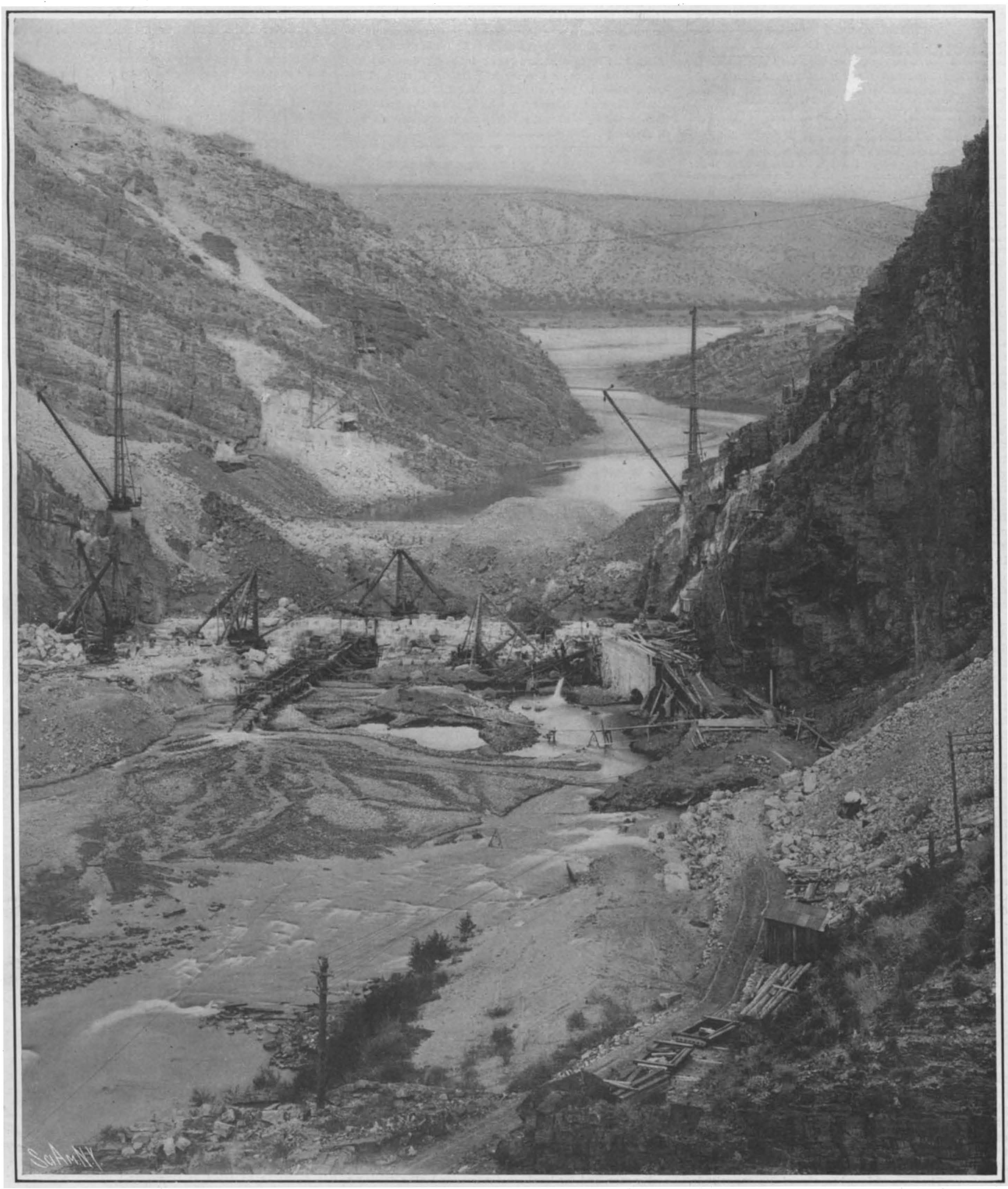

General View of the Site of Roosevelt Dam, Which, When Completed, Will Provide Water for Irrigating More Than a Quarter of a Million Acres of Arid Arizona Land.

THE GREAT ROOSEVELT IRRIGATION DAM.—[See page 10.]

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NEW YORK, SATURDAY, JULY 4, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE FASTEST WARSHIP AFLOAT.

The United States navy possesses in the scout cruiser "Salem" the fastest warship in the world. In the recent government standardization trial over the measured mile course off Rockland, Maine, this handsome vessel was driven at a maximum speed of 26.88 knots, and at an average speed for five runs over the mile course of 25.95 knots. This result is particularly gratifying because of the fact that the "Salem" is equipped with Curtis turbines, a type which is distinctly American, having been developed entirely in this country. The "Chester," a sister ship driven by Parsons turbines, has the distinction of being the second fastest warship afloat, her official standardized speed, as determined by the government board, being 25.07 knots for five runs over the mile course, and 26.22 knots for her fastest mile. In claiming that these two are the fastest warships afloat, the term is restricted to vessels which, because of their size, are entitled to rank in the cruiser class. The torpedo-boat destroyers, whose speed, of course, is very much higher, rank more in the boat than in the ship class, and should be considered by themselves.

Reports have been cabled from the other side of the Atlantic to the effect that the cruiser-battleship "Indomitable" steamed at higher speeds than these; but the reports lack verification, and indeed a semi-official organ has stated that the builders were satisfied to secure the 25 knots called for by contract. The Parsons turbines were not pushed much beyond the 41,000 horse-power, which, it was estimated, would be sufficient for the contract speed.

In addition to the "Salem" and "Chester," the scout class includes the "Birmingham," which is equipped with reciprocating engines; and advantage is to be taken of the opportunity thus afforded to carry out competitive trials of the three boats under absolutely identical conditions. The trials will be made simultaneously, with the boats in close proximity to each other and using the same quality of coal. Several runs will be made off the Maine coast at different speeds, when careful measurements will be taken of coal and water consumption, and much other technical data will be secured. The unrivaled opportunity thus afforded for testing the three leading types of motive power has never before been presented; and the results cannot fail to have a far-reaching effect in the field of marine engineering. In a subsequent issue, we hope to give the full official data secured during the recent run of the "Salem."

PRESENT CONDITION OF THE PAN-AMERICAN RAILWAY.

Attention is directed again to the ambitious project for a Pan-American railway, by a recent report on that subject. Apart from its sentimental interest, the plan of connecting North America with the countries of Central and South America is destined to have an exceedingly important effect, both in developing Central America and in increasing the volume of commercial business between the United States and South America. The enterprise, because of its magnitude, can never be undertaken *in toto* by any single corporation. In this respect, it is not unlike the proposed Cape to Cairo railway in South Africa. It has come to be recognized, on both continents, that a main artery of such enormous length can be commercially successful only if the individual states and countries through which it is to pass are opened up by means of feeder lines, for the development of the local territory which is to be traversed. If this be done, the main line, upon its completion, will find a considerable amount of traffic already available. According to the report, about four thousand miles of the total ten thousand four hundred miles necessary to connect New York and Buenos Ayres have yet to be completed. At present, about four hundred miles of this gap are under construction, which leaves thirty-six hundred miles to be undertaken before the system is completed. The various governments are living up to their pledges of assistance, by making land grants and by giving financial and other support. There is to-day a continuous stretch of railway communication from the latitude of Hudson Bay to the southern line of Mexico; and in South America there is unbroken railway communication from Buenos Ayres to the Bolivian border line. Also, in South America, work is being done on the connecting links in Colombia, Ecuador, Peru, and Bolivia, while interoceanic lines are being constructed in Costa Rica and Nicaragua which, when the main line is completed, will act as important connections and feeders.

CONSERVATION OF OUR FUEL RESOURCES.

It would be a mistake to suppose that the recent gathering at the White House, to promote the conservation of the natural resources of the country, was the first official step taken by the government for that purpose. Everybody is aware, or should be, of the good work that is being done by the government in the Department of Forestry in the preservation of our timber supply; and equally, if not more important, have been the labors of the United States Geological Survey in the effort to conserve our natural supplies of fuel by the very simple expedient of teaching us how to use what we do consume, to better economical advantage. In carrying on its work of testing the fuels used by the government, the Geological Survey has gathered data of wide variety, which have proved to be of great economical value in the industrial world. The work of the department in the investigation of the gas engine alone, has been very valuable in showing its high economy as compared with the average steam engine. It has proved, for instance, in its testing plant, that the gas engine will develop from two to three times as much power from a given amount of coal as is being developed to-day from steam engines of the same capacity—the degree of comparative economy depending, of course, upon the conditions under which the steam engine is being operated. In this connection, the tests which have been made of the fuel value of various coals have established the important fact that many coals, which are practically worthless for steam raising, are entirely serviceable for use in gas producers. The importance of this investigation in its bearing upon the fuel supplies of the West, can scarcely be overestimated; for the supplies of high-grade coal in the West are very limited, while there are millions of acres of the poorest forms of coal, known as lignites. It is largely due, furthermore, to the labors of the Survey, in making a general analysis of the coals of the country, that coal is now being purchased on the basis of its heating value, definite specifications being drawn up, covering this and kindred features. The beneficial effects of this system have been shown in the case of the State, War, and Navy Building in Washington, in which, under the new system, the government is said to be saving fifteen thousand a year in the coal bill alone.

POWER CONSUMPTION IN THE RAPID TRANSIT SUBWAY.

Striking evidence of the accuracy with which the electrical engineer is able to calculate beforehand the amount of power which will be necessary to perform a specified duty, is afforded by the statistics of operation of the New York Subway and by tests which were recently made by Mr. Stillwell, the designer of the electrical features of that system.

In determining the capacity of the motors for the subway cars, there was but little data available that was applicable to the case in hand. The Manhattan Elevated Railway, it is true, supplied some data; but the trains were lighter, were run at slower speed, and in the open. The results obtained with the electric cars in the London "tubes" were vitiated by the fact that the trains were lighter and slower, and particularly by the fact that, since they practically filled the tubes, the air resistance was of a different character from that which would be encountered in the rapid transit subway. It was finally decided to use, for express service, eight-car trains, of which five were to be motor cars, and for local service five-car trains, made up of three motor cars and two trailers. Each motor car was provided with two 200-horse-power motors, thus giving a capacity of 2,000 horse-power for the expresses, and 1,200 horse-power for the local trains. The accuracy with which electrical estimates of this character are now made by competent engineers, is shown by the fact that in their daily service, the motors have given slightly better results than were called for by the specifications, and this in spite of the fact that, in the later months of service, heavier cars have been adopted than were originally planned.

When we bear in mind that in weight, speed, capacity, and rate of acceleration, this road is in advance of any current practice in the world, or at any rate, was so at the time of its design, these results must be admitted to be extremely creditable.

The results of the tests show that although, during rush hours, the speed of the express trains sometimes falls below 25 miles per hour, this falling off is due to the increase in the length of station stops beyond the average of 25 seconds per stop anticipated in the preliminary calculations.

As regards the possibility of increasing the capacity of the subway, there is little hope of any relief from an increase of the power of the motors. Under existing conditions of handling the traffic, faster runs between stations would simply mean longer stops by signal at the entrance to stations. We are inclined to think that the best means of accelerating the service is that offered by Mr. Arnold in his recent report to the Public Service Commission, in which he advocates the double-decking of the express stations, and the provision at these stations of two tracks for each express track—a provision which would enable two express trains running in the same direction to unload and load their passengers at the same time.

STEEL TIES ON ROADS WITH HEAVY TRAFFIC.

Apropos of the question of conserving the natural resources of the country, among which our timber supplies are those that are being the most rapidly depleted, the question of the use of steel in place of wooden ties becomes of increasing importance. Generally speaking, experiments made by various railroads with steel ties have not given the encouraging results that were looked for; but the failures have not been of such a character as to prove that the steel tie is inherently and essentially unfit for railway service. Rather, we are inclined to think the failures have been due to details of form and fastenings. This is borne out by the fact that an important mineral road, the Bessemer and Lake Erie Railroad, which carries the heaviest mineral traffic of any system in the world, has adopted the steel tie as standard, using what is known as the Carnegie I-beam type. The road runs from Conneaut, Lake Erie, to Bessemer, Pa., a distance of 154 miles; it is full of undulating grades and a large amount of curvature, in which curves of four to six degrees are frequent, with a few of even sharper curvature. Last year the road carried twelve and a half million net tons of freight, and adding the passenger trains, the gross tonnage was over twenty millions. The locomotives weigh 125 tons, and over 90 per cent of the freight cars carry from 55 to 60 tons of freight apiece; conditions which, as every railroad engineer will recognize, are very trying upon the track and roadbed.

The experiments with steel ties began in 1900, when the company laid half a mile of track with inverted trough-shaped steel ties. When these failed to give satisfaction, except so far as they proved in their eight years of service that corrosion of the metal was quite insignificant, four and a half miles of track was laid with a heavy I-beam tie. The results were so encouraging that an improved tie of this section has been adopted as standard on the whole road. The track construction consists of 100-pound rails, 33 feet in length, with twenty steel ties to the rail. The ties are 5½ inches deep, 8½ feet long, with a top face 4½ inches and a bottom face 8 inches wide. The rail is held to the tie by means of a clip on either side bolted to the top flange. We understand that the company's engineers regard that portion of the tracks which is laid with steel ties as being superior, on every point of comparison, to that which is laid with wooden ties. The fastenings hold the rails absolutely to gage, even on very sharp curves; and they are more effective in preventing creeping of the rails—a phenomenon which, under certain conditions, has caused a large amount of trouble and expense. Moreover, the behavior of the ties under derailments is admirable, for they show merely a slight bending of the flanges, under conditions in which the wood ties have been completely wrecked. Finally, it has been proved by carefully kept records of the road, that the expense of maintaining the steel-tie track in level and alinement is 25 per cent less than it is on wooden-tie track.

The new Zeppelin airship, which is 426 feet long and 43 feet in diameter, and which has a carrying capacity of twelve men and a radius of action of 1,440 miles, is about to be tried in Germany. Before purchasing it, the government has made the requirement that it shall be capable of landing on the ground safely instead of on floats on Lake Constance. It is expected to make a long-distance flight from Friedrichshaven to Mayence.

THE IRRIGATION OF EGYPT AND THE SUCCESS OF THE ASWAN DAM.

Although frequent adverse reports have been circulated respecting the policy of the British administration in Egypt in sinking such a vast amount of money in the construction of the Aswan barrage, the official statements for the year 1907, which have recently been published concerning the results of the irrigation arrangements during that year, offer conclusive evidence respecting the foresight of the responsible authorities, especially of Sir William Garstin, through whose initiative the enterprise was carried to conclusion. During the past year the Nile reached the lowest level that has yet been reached in the history of modern Egypt since 1877, and it is pointed out that but for the existence of the vast volume of water impounded by the dam to supplement the low Nile during the season of drought, the country would have been plunged into the horror of a famine. The year under review constituted the eighth successive lean year so far as the river flood was concerned. On January 1 the gage reading at Wady Halfa presaged the impending state of affairs, since the record was 11.8 inches below the average of the preceding years. The low readings prevailed until the middle of March, when an improvement took place, and the river levels were well maintained until June 5, at which date they were 7.8 inches above the normal. Then unfortunately a rapid fall ensued for ten successive days.

On June 15 the annual rise of the river commenced, but the date was very late, and the rise itself slow and feeble. The maximum height of water recorded at Aswan, and the duration of the period the river remained below the average level, were the worst instances on record since the irrigation works were started in the country. It became imperative that every ounce of water should be carefully husbanded, and so black was the outlook, that the authorities were considerably perturbed. In the third week of September, however, a slight improvement took place. "Had it not been for this relief," states the consul-general in his latest report, "the results as regards flood irrigation would have been little short of disastrous."

The filling of the Aswan reservoir commenced on November 26, 1906, and eight weeks were occupied in the operation, which was completed by January 15 of last year. Discharge from the reservoir to supplement the volume of water in the river was begun on April 1, and by August 1 the reservoir was emptied. Owing to the adverse conditions prevailing, the work of regulating the water discharge so as to secure the most useful and economical results required a considerable amount of study and calculation upon the part of the engineers in charge of the dam. The success achieved, notwithstanding the poorness of the flood in providing a sufficient quantity of water for the summer irrigation of last year, the consul-general attributes very largely to the skillful management of the irrigation engineers. The result was that the area of unirrigated land was reduced to very small proportions.

Some idea of the benefits that have accrued to Egypt by the realization of this barrage scheme, in addition to its salvation of the crops of last year, may be gathered from the steady diminution of unirrigated land that has been effected every year since the work was completed. In 1877 the low and poor flood resulted in over 1,030,000 acres of land being deprived of its water supply. In 1907 the extent of this area was only 115,756 acres, showing that, as a result of the barrage, some 90 per cent of the area affected by a low Nile thirty years ago has been definitely assured of a water supply during the summer.

As is well known, it has been decided to increase the height of the Aswan barrage by 16.5 feet, and the water level by 23.1 feet, the result of which will be to more than double the present capacity of the reservoir. The scheme has been severely criticised, but the fact that it will exercise considerable influence upon the country cannot be disputed. It will bring under cultivation an additional 1,000,000 acres of excellent land in the Delta, by insuring a summer supply of water just at the time when it is most urgently required by the crops. The works are now in active progress. At first it was suggested that public tenders should be secured for carrying out the enterprise, but wiser counsel prevailed, it being urged that under the peculiar circumstances greater advantage would be secured by intrusting the scheme to the original constructors, since they were familiar with the special difficulties that would have to be surmounted. Work has been commenced on the foundations, and it is estimated that the task will occupy five years. The total cost, including compensation for inundated property in Nubia, and the preservation of the Nubian monuments, will approximate $7,500,000.

Other irrigation works of large dimensions are in progress or having the preliminary surveys prepared. These will affect more particularly the Soudan, but it is held that Egypt should have first claim upon such works for storing the water of the Nile. The Esneh barrage is rapidly approaching completion, together with numerous distributing channels and ditches. Surveys of the Blue Nile are in progress in connection with the barrage that it is proposed to throw across the river at Sennar. This work cannot be taken in hand however until the railroad is pushed forward to that point for the transport of the necessary supplies. It is also proposed to remodel the White Nile together with the laying out of a complete canalization and drainage system of the country through which it passes, which will result in obtaining a considerable area of highly fertile land. This work, however, is considerably hampered by the high level of the river in autumn and winter months. Two years will have to elapse before it will be possible to prepare accurate estimates for the work projected.

SPECIAL SCHOOLS FOR EMINENTLY GIFTED PUPILS.

Prof. Petzold has made the interesting suggestion of founding some special institution devoted to the education of the intellectual *élite*. He hopes thus to rear an intellectual aristocracy, which in his opinion would exert a far greater influence on the development of civilization than large numbers of moderately gifted individuals.

It may be said that the pupils of the average college can be intellectually classified into three sets, the highest of which comprises the few eminently gifted (about ten per cent of the total), the intermediate class of which constitutes the intelligent but less brilliant average pupils, who number about eighty per cent, and finally the lowest class which constitutes roughly about ten per cent of the total. It is a pedagogic truism that all teachers endeavor to fit as many as possible for an upper class, and that they are compelled to devote most of their time to the moderately gifted and even to the less intelligent pupils, repeating over and over again the same rules of grammar and the same mathematical theorems to the intense weariness of the more gifted. Hence the students blessed with exceptional mentality are never trained fully to take advantage of their capacities, and dwell in intellectual semi-idleness. It may be said that practically all schools are intended mainly for the benefit of the moderately gifted, the interests of both the less gifted and best pupils being sacrificed.

The demand for a progressive individualization of instruction is now more keenly felt than ever, largely because of the uniformity in the curriculum of most schools and colleges. A step in attaining this goal would be taken if *élite* schools could be founded.

THE EMANATION OF SODIUM.

In a recent issue of Nature appears a description of the action of what appears to be an emanation or volatile vapor liberated by the surface of freshly-cut metallic sodium. The phenomenon was observed by C. E. S. Phillips during the course of some experiments upon the contact potential difference between the alkaline metals and glass. Freshly-cut sodium rapidly discharged an electroscope, the action occurring only if gold leaf was negatively charged, and ceasing completely when a membrane of celluloid was introduced, sufficiently thin to give interference colors. That the discharging action is due to a vapor would seem to follow from the fact that a small current of air, directed so as to carry the supposed gas away from the charged plate of the electroscope, enabled the leaf to retain its charge. All action ceases on the prolonged heating to the melting point of the metal. After some hours, if allowed to stand, the sodium shows signs of recovering its power. Inasmuch as all portions of the same block of sodium do not exhibit the action to the same extent, the effect may be due to some radioactive impurity. Experiments are now in progress for the purpose of concentrating the active parts, to decide whether or not the phenomenon may be thus explained, or whether sodium really has an emanation.

THE CURRENT SUPPLEMENT.

The opening article of the current SUPPLEMENT, No. 1696, deals with the disposal of New York city's refuse. The author is Mr. H. deB. Parsons, a well-known civil engineer, who writes with authority on the subject. Mr. Pigg's exhaustive paper on locomotive cab-signaling devices is brought to a conclusion. A better review of the entire state of the art than Mr. Pigg has given can hardly be desired. Some sensible observations on mechanical flight are published, the burden of which is that slowness, and not speed, should really be the ultimate aim of flying-machine designers. Prof. Korn's telephotographic apparatus will soon be introduced in this country in an experimental way. In view of this fact, a very complete description of the instrument, in which even the technical details are entered into, is published. The article is written by the Paris correspondent of the SCIENTIFIC AMERICAN, whose information has been obtained from a personal study of the machine during its construction in Paris. The vital necessity of preserving our trees from the ravages of fungi is set forth in an article tellingly illustrated by several striking photographs.

SCIENCE NOTES.

Illness having followed eating oysters of a decidedly bluish green color, an analysis made by J. T. Willard disclosed the presence of copper to the extent of 0.212 per cent of the dry substance in one instance. Other tests of fresh and canned oysters on the Kansas market showed copper to be present in every case. Twenty-six samples from various localities were secured directly from the shells, and copper found in every instance, the average amount in the dry substance being 0.059 per cent. Copper seems, therefore, to be a normal constituent of oysters, and it is probable that some individuals may be affected by it when present in the larger amounts.

The method which has been worked out by A. De Quervain for observing air currents in the upper atmosphere by means of small balloons is now used with success on the Continent. During moderately clear weather, the balloons are sent up at intervals, and they are observed by a special form of theodolite so that the azimuth and angular height of a balloon is always seen. To determine the exact position, a length must also be known, and this is given by the height of the balloon, by multiplying the ascending speed by the time which has elapsed since the start. It is found that the speed of rise can be taken as about constant for the greater part of the ascension. The instrument will follow the balloons for nearly forty miles distance, and the height depends on the size of the balloon. It may reach six miles. The present method was used at Zurich in January of last year, during the period of unusual barometric pressures, which were extremely high in Europe. Balloons were sent up every day and were observed at a maximum height of 22,000 feet. From the 17th to the 21st, during which period the anti-cyclone center was shifted, while remaining near the English Channel, the observations showed a remarkable fact in the existence of a north current above 13,000 feet altitude. It was also noted that during the period the direction of the currents turned from right to left as the altitude increased, which is contrary to the general rule. The Meteorological Institute of Switzerland intends to continue this work during the present year, and it will no doubt be a valuable aid in the observation of upper air currents.

A paragraph recently appeared in a contemporary pointing out that the ancient Assyrian records afford practically conclusive evidence as to the former existence of elephants in the Euphrates valley. Confirmation of this is afforded by the discovery in Armenia during the Crimean war of fossil or sub-fossil remains of an elephant apparently intermediate between the living Indian species and the mammoth. Under the light of the new evidence there seems, however, little doubt that the Euphrates elephant was a western race of the Indian species, which was killed off during the early historic period. Mention of the mammoth reminds me that an American writer has recently given a restoration with the tips of the tusks curving downward instead of upward. It is suggested that the tusks were employed somewhat in the fashion of rakes for digging in the snow. Unfortunately for the theory, the skull of the Ilford mammoth in the British Museum shows that the upward curvature of the points of the tusks is correct. One other point connected with elephants has much interested me. A gentleman recently brought to the British Museum about half a peck of stones asserted to have been taken from the stomach of an African elephant. The stones are quite angular and unworn. It was stated by the donor that other instances of the same nature are known to hunters. If such stones are habitually swallowed by elephants, one wonders, in the first place, that they do not seriously damage the molar teeth, and secondly, why it is that they do not become rounded. It may be added that the same gentleman recently demonstrated the existence of the stone-swallowing habit in crocodiles.

THE OUTCOME OF THE LEMOINE CASE.

News comes from Paris that Judge Poittevin has been suspended from the bench for three years for allowing Lemoine, the diamond manufacturing swindler, to have his freedom after he was arrested, thus enabling him to escape.

Judge Poittevin justifies his action on the ground that the diamond industry and the diamond workers were threatened by Lemoine's pretensions to be able to manufacture the gems, and he deemed it the quickest way to establish quietude to allow Lemoine to prove himself a swindler.

The Appellate Division of the Supreme Court of the State of New York has decided that the Fifth Avenue Coach Company, which operates a coach line on Fifth Avenue, could not display signs or advertisements on the exterior of its coaches. The court held that the displaying of such signs is not a necessary incident of the plaintiff's business. When we consider the advertising which is carried on the omnibuses and motor boats of Paris and London, we may indeed be thankful that New York has been spared.

THE CURIOSITIES OF FEELING, HEARING, SEEING AND SMELLING.

BY JACQUES BOYER.

There has been in operation for some time, at the Sorbonne, a laboratory which is little known to the public but which is the scene of very interesting experiments in the measurement of bodily sensations. Nearly all of the ingenious apparatus employed in these experiments was invented by M. Charles Henry, the director of the laboratory.

Sensation is the state of consciousness which is produced when an organ of sense is affected by sound, light, heat, or any other physical agent. Sensations, in fact, are all that we know directly and to them alone we owe our consciousness of the existence of the universe. Scientific men endeavor to substitute for crude sensations, depending on many circumstances and consequently difficult to observe with accuracy, purified sensations, agreeing with each other as closely as possible and thus appearing to be independent of the individual and his particular condition. Since, then, there is an evident connection between the action of the environment and the reaction of the senses, the task of the physiologist consists in determining with precision the intensity of the stimulus required to produce each sensation, in tracing the curve of results and in calculating therefrom the mathematical formula. The principal difficulty is to obtain the necessary precision and to extend the examination to sufficiently wide limits. This field of research has scarcely been explored and consequently it was necessary to devise new apparatus for every case.

For visual sensations Henry constructed a photoptometer based on the principle that the amount of light which passes through an opening in a diaphragm is proportional to the area of the opening. The rays emitted by the source of light traverse an oiled paper before they reach the diaphragm, and form an image of the opening on a screen placed before the eye. By varying the size of the opening and the power and distance of the source any desired intensity of illumination can be obtained, and by noting carefully the sensations produced the law can be determined.

Henry's pupilometer (Fig. 1) is used in demonstrating the direct effect of light on the iris. The apparatus consists of a series of three cylinders. The smallest cylinder terminates in a diaphragm pierced by a small hole which is placed at the anterior focus of the eye (12.8 millimeters or about ½ inch in front of the cornea). The outermost and largest tube is closed at its outer end by a disk of ground glass 4 inches in diameter, which is marked with concentric numbered circles. When the image of the pupil formed by the aqueous humor coincides with one of these circles the pupil is magnified 10 diameters. The iris is illuminated by light coming through the peripheral part of the ground glass, outside of the image. By applying to the ground glass rings of blackened copper and colored glass, with openings exactly equal in diameter to the image of the pupil, and suddenly removing these rings, the effects produced on the pupil by changes in the illumination of the iris can be studied by a method which makes no change in the illumination of the pupil itself. Experiments with this instrument prove that dilatation of the pupil almost invariably follows darkening of the iris.

M. Henry has also succeeded in measuring the acuteness of mental vision with the aid of a simple and original apparatus (Fig. 6). In other words, he has proved that the pupil can dilate under the influence of the brain. The experimenter views through a convex lens a card bearing a simple diagram and moves the card along a scale until the diagram is barely discernible. The diameter of the pupil is then

(*Concluded on page* 8.)

Fig. 1.—Henry's Pupilometer, Used to Determine the Direct Effect of Light on the Iris.

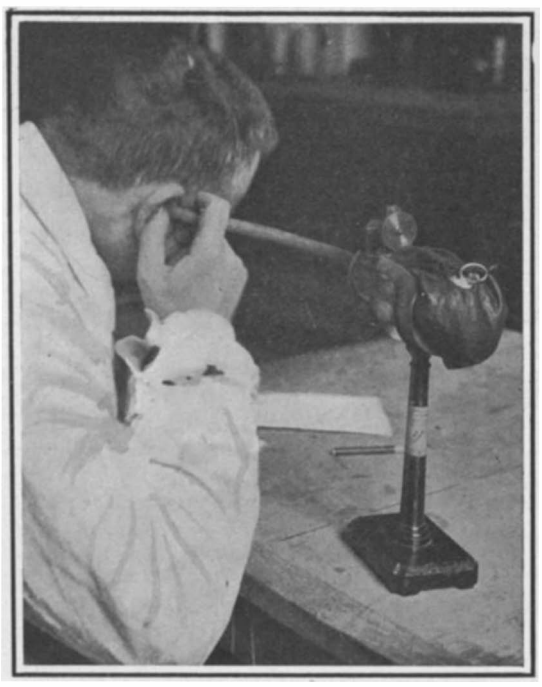


Fig. 2.—Testing the Hearing with the Audiometer.

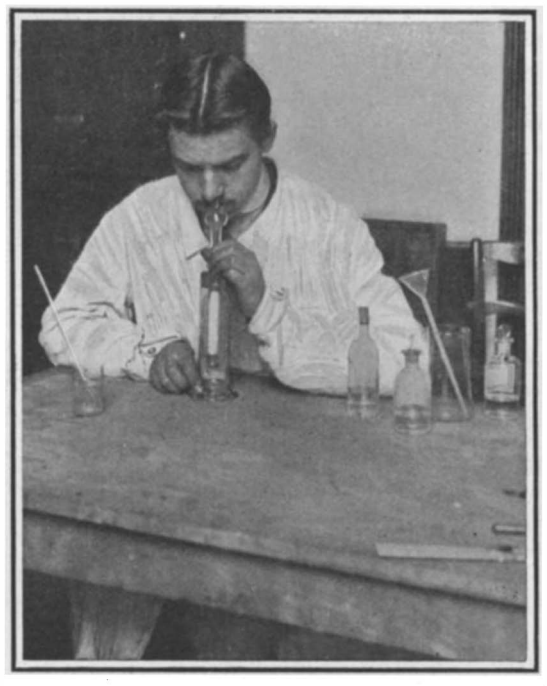


Fig. 3.—Henry's Olfactometer for Measuring Acuteness of Smell.

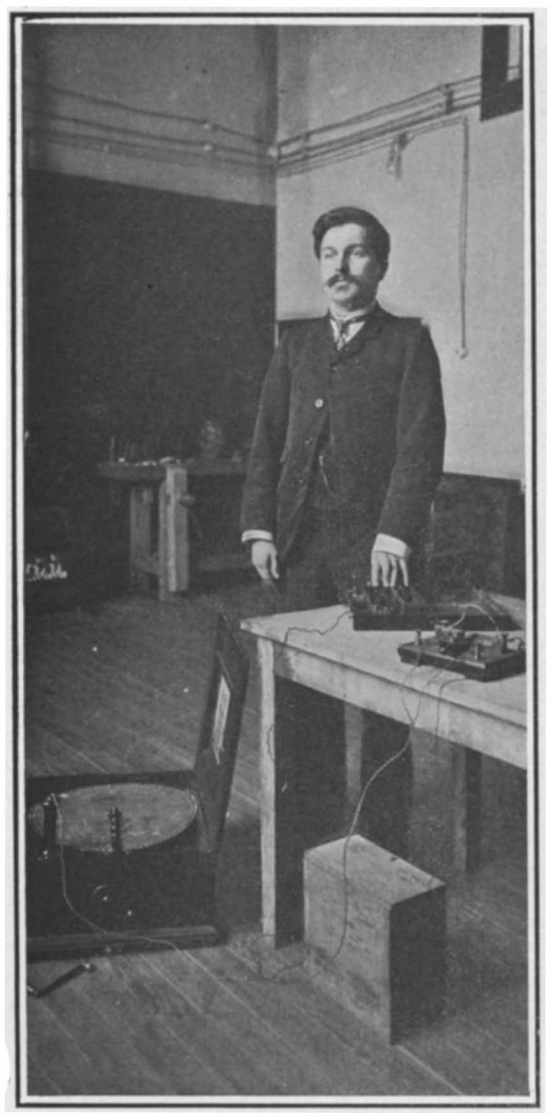


Fig. 7.—Applying Alternating Currents Induced by Musical Vibrations to the Body.

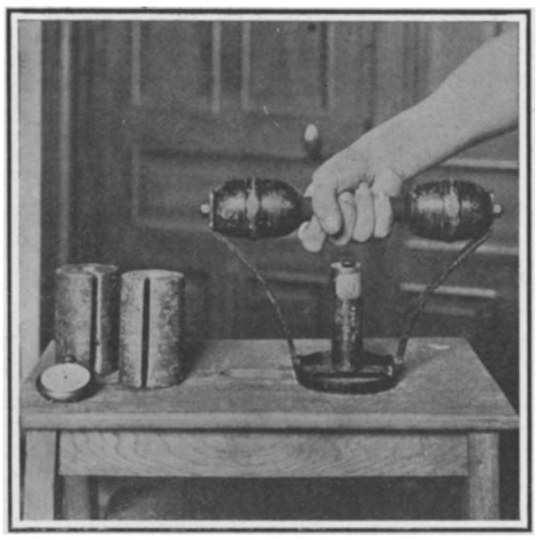


Fig. 5.—Dumb-bell for the Study of Fatigue.

Fig. 6.—Henry's Apparatus for the Study of Mental Vision.

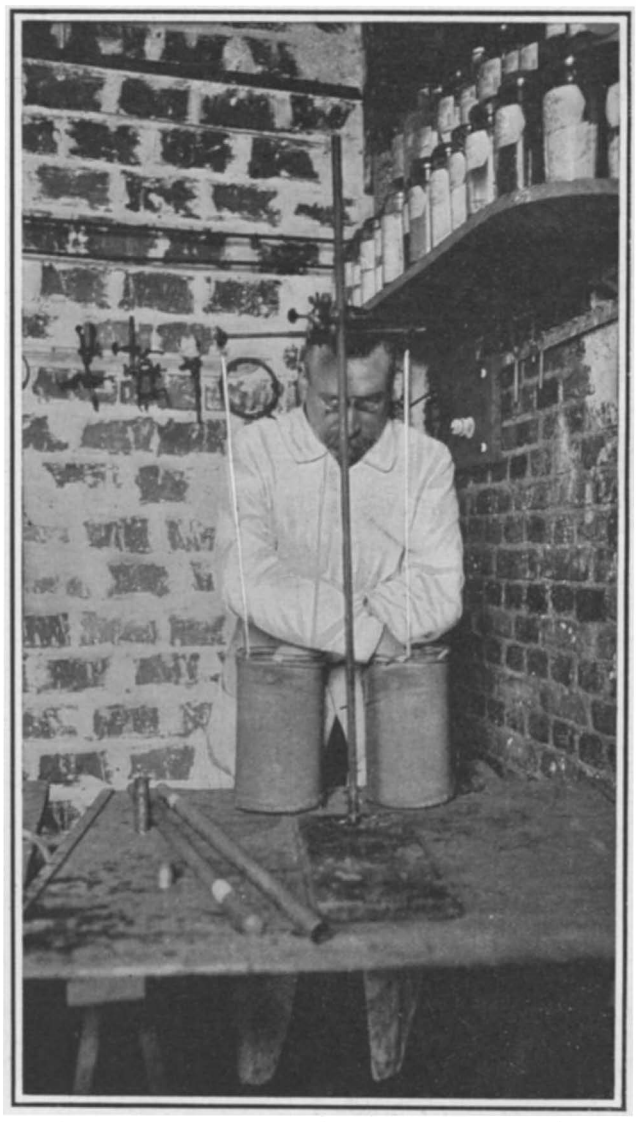


Fig. 4.—An Experiment in Thermal Sensation.

THE CURIOSITIES OF FEELING, HEARING, SEEING AND SMELLING.

THE CALIFORNIA CONDOR.

BY WILLIAM L. FINLEY.

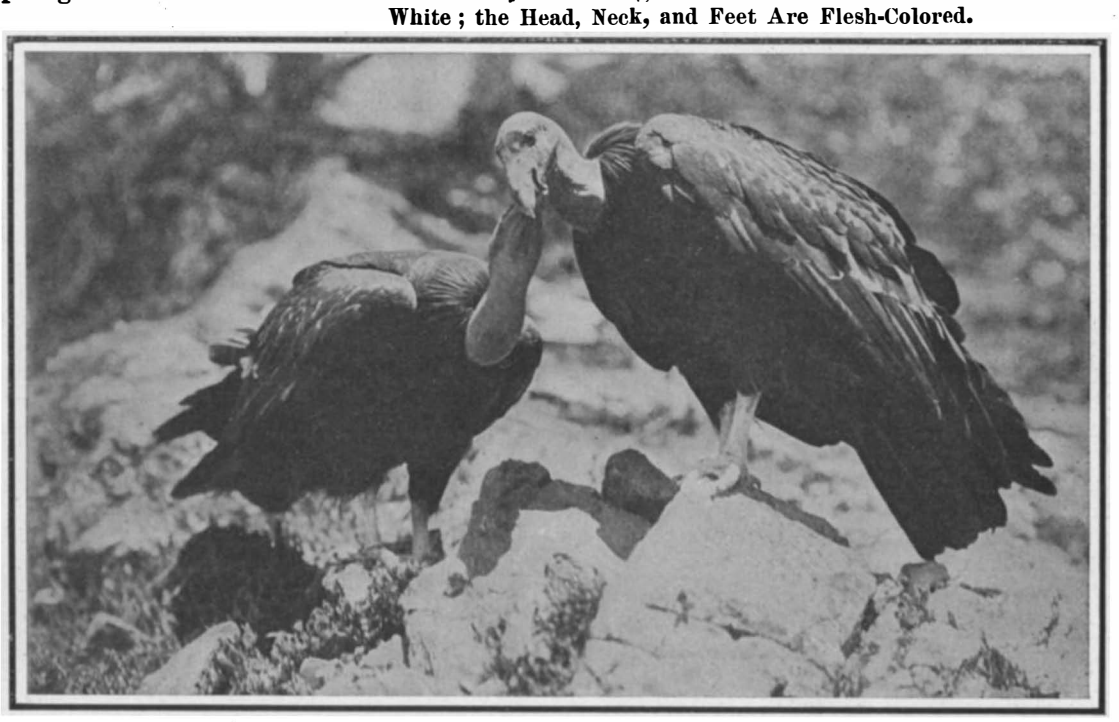
The report that the California condor (*Gymnogyps californianus*) will soon become extinct is not without foundation. It has a range more restricted than any other bird of prey. Since the time when the western part of the United States was settled, the breeding range has contracted, and the condor's numbers have greatly decreased; although it is still found in the wilder mountainous sections, it is nowhere common.

The main cause which has been given for the decrease in condor numbers seems to be that when stock raising became common in California years ago, in order to secure pasture during the dry months, the rangers were compelled to drive their herds back into the more remote mountainous parts. Here they invaded the retreats of panthers, grizzlies, and coyotes. These preyed upon calves and sheep and created considerable damage. The quickest and best way of getting rid of these animals was by baiting the carcasses with poison. Since the condors came to feed on the poisoned animals, numbers of the big birds were undoubtedly killed in this way. Almost any other bird might hold its own in the struggle for existence against these forces, but the condor is too slow in recuperating its numbers. Even under favorable circumstances, each pair of condors will raise but one offspring a year. Oftentimes a pair of condors are very irregular in nesting. One collector states that in a certain locality where a pair of the birds live, they have nested but three times in about twelve years. Under these conditions it is not surprising

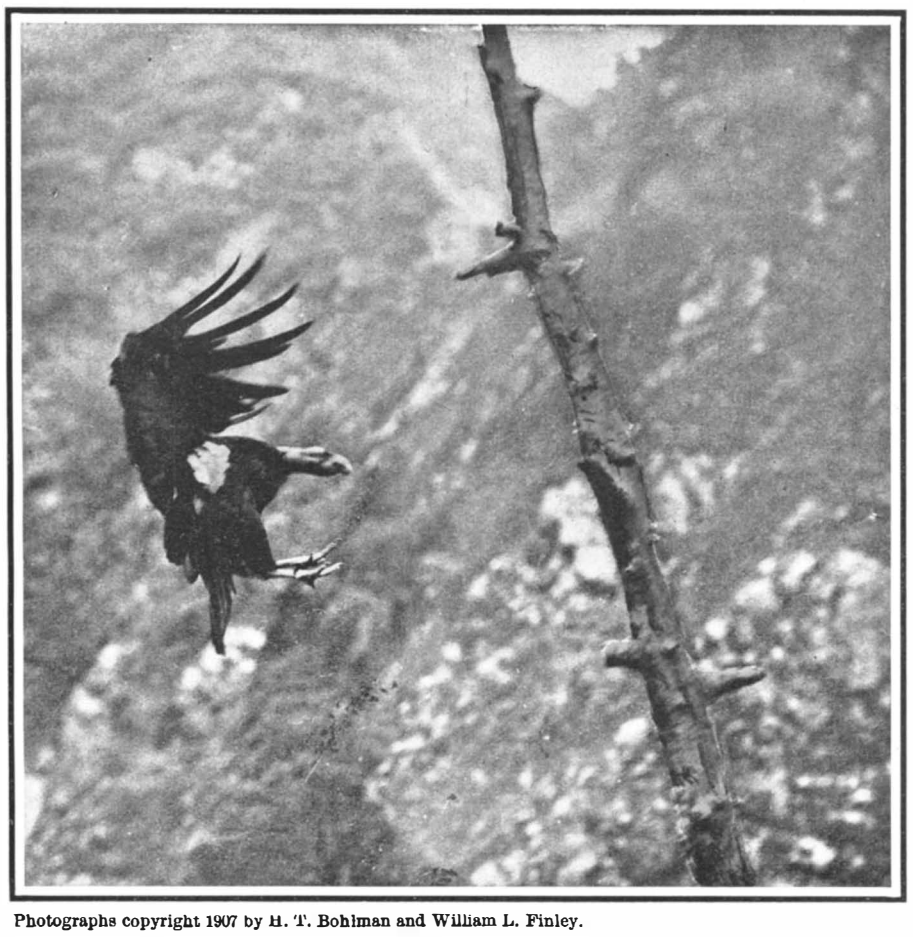
Nest and Egg of the California Condor, Showing the Material Composing the Floor of the Nest Cave.

Condor Chick One Day Old. Weight Less Than One Pound. The Down is White; the Head, Neck, and Feet Are Flesh-Colored.

Young Condor, Fifty-four Days Old. Weight About Seven Pounds. No Feathers as Yet.



Condors Are Very Affectionate. They Like to Nibble and Caress Each Other. These Birds Are the Parents of the Young Bird Shown at the Left.



Photographs copyright 1907 by H. T. Bohlman and William L. Finley.

"Engines Reversed." The Condor Is So Heavy and Its Momentum So Great That It Alights On a Tree With Difficulty.

In Their Demonstrations of Affection the Birds Sometimes Crowd Each Other Off a Perch.

THE CALIFORNIA CONDOR.

that the condor numbers are decreasing, and unless the needed protection is given, this bird will undoubtedly follow the great auk.

The best early historical account of the California condor was published in Hutchings' California Magazine in the June, July and August numbers of 1859. It was written by Mr. Alexander S. Taylor. Although the bird had been known to the scientific world since mentioned by Shaw in 1779, yet neither the bird nor the egg had been properly described, except from hearsay. Both Douglas in 1827, and Townsend in 1837, as related in Audubon, failed to discover the nest or ever got to see the eggs. Douglas assumed and stated dogmatically that the color of the egg was "jet black," which information was secured from the Indians.

It is interesting to note that the egg taken at this time, from which Mr. Taylor secured his description, is still in existence. This is very likely the oldest egg of the California condor, and is now in the collection of J. H. Gurney in England. The egg was secured from a hunter who took it the last week in April, 1859. Mr. Taylor recounts that the egg was laid in the hollow of a tall oak tree near the summit of one of the highest peaks in the vicinity of Tularcitos, near a place called Cunejos. This is the only record we have of the condor ever nesting in a tree, and although this record has been repeated in many books on ornithology, it cannot be regarded as completely authentic. It may safely be said that the nesting site of the California condor is always a pot-hole in the side of a cliff, a cave, or a recess in behind a large rock on the steep mountain side. There is no effort at nest building, but the single egg is laid on the bare ground.

The egg which Mr. Taylor secured weighed ten and a half ounces and the contents weighed eight and three-quarter ounces. A specimen that was killed on the beach at Monterey at this time was carefully measured by Mr. Taylor. It weighed twenty pounds; from beak to the end of tail feathers it measured four feet and a half; from tip to tip of wing it measured eight feet four inches; one wing, three feet three inches; tail feathers, twelve in number, fifteen inches long.

As to the size of a full grown California condor, Mr. Frank Stephens says: "I believe that a bird that measures full ten feet, laid on its back on the floor and marked at wing tips without really stretching the bird, is an exceptionally large bird." Mr. Stephens gives the measurements and weights of six different condors as follows, the first three killed at Julian, the fourth at Ballena, and the other two at Santa Ysabel, California.

1. March 13, 1888; length, 44.1 inches; spread, 102.4 inches (1,120x2,600 millimeters); female, not quite mature; weight, 16 pounds.

2. May 11, 1888; length, 45.7; spread, 112.2 (1,160 x 2,850 millimeters); adult male; weight, 19 pounds, eviscerated.

3. June 2, 1888; length, 43.1; spread, 110.7 (1,095 x 2,812 millimeters); weight, 21 pounds.

4. June 25, 1888; length, 44.3; spread, 110 (1,125 x 2,794 millimeters); adult male; weight, 20 pounds.

5. May 10, 1899; length, 44; spread, 112 (1,118 x 2,848 millimeters); female, not quite mature.

6. May 24, 1899; length, 45; spread, 112 (1,140 x 2,845 millimeters); adult male.

In some of our works on ornithology, the authors seem to think that the California condor lays two eggs, although there is no authority for such a statement, except by analogy with the turkey-buzzard.

One collector states, "I know positively of three instances where they laid but one egg and no instance where they laid more than one. I have talked with other men that know and they say they lay only one egg at a setting, which I am satisfied is right." Another collector gives these facts. "A condor never lays a second egg in the same season. I have taken eight of them, and never more than one in a nest. Most people think that the bird lays two eggs. I have investigated several such stories and always found them to be buzzards' nests."

Fourteen different eggs of the California condor show the following measurements in inches: 2.48 x 4.08, 2.53 x 4.28, 2.55 x 4.39, 2.58 x 4.57, 2.59 x 4.52, 2.60 x 4.30, 2.62 x 4.38, 2.62 x 4.44, 2.62 x 4.52, 2.65 x 4.40, 2.68 x 4.28, 2.68 x 4.50, 2.70 x 4.50, and 2.73 x 4.22.

The size and strength of the condor have often been exaggerated. There have been many absurd stories about these birds killing sheep and other animals. A short time ago I saw an account in a daily paper of where a hunter claimed he saw a condor sailing away with a hind quarter of venison in its talons. Mr. Alexander Taylor makes the statement that this vulture has been known to kill and carry off a hare in its claws. It is extremely doubtful that one of these birds would ever attack a living animal. The habit of this vulture is to wait till after death. As to the condor's carrying its prey, this is easily discredited by a study of the condor foot. The claws are blunt and weak, and the foot is not adapted for grasping or carrying as an ordinary bird of prey.

In regard to the range of the California condor, it is sure to be somewhat vague as long as we have wide stretches of rough mountainous regions in the West where little or no study has been given. We find a few scattered in the San Jacinto Range, which is a small range about forty or fifty miles from the coast extending through Riverside and San Diego counties. A few have been noted in the lower end of the San Bernardino Range during recent years. Where the San Gabriel Mountains cut through Los Angeles County, condors are a little more numerous, and from this district throughout the mountainous regions of Los Angeles, Ventura, Santa Barbara, San Luis Obispo, and Monterey counties, the largest number of these birds are found, but they are nowhere common. There have been a few straggling records of the condor north of Monterey County in California, but none of recent date. The most striking record on the present range of the California condor is one from Douglas County in southern Oregon. This seems very unusual, as we can find nothing else in recent years of the bird living between the San Francisco region and this place, although it is a stretch of several hundred miles.

The Oregon records were given by Mr. George Peck and his son Mr. Henry Peck, who are both reliable ornithologists, and who were both well acquainted with the bird in southern California. Mr. Henry Peck informs me that on or about July 4, 1903, he and his father saw two California condors at Drain, Douglas County, Oregon. They were quite high in the air and were sailing about over the mountains. The elder Mr. Peck saw them several times after that. He states the birds were instantly recognized by both of them. Again in March, 1904, Mr. Henry Peck writes, "I saw four condors which were very close to me, almost within gun shot. I recognized them first by their size, and second by the white feathers under their wings. The birds were all flying very low, as there was a high wind blowing." Mr. Peck also gives the record of a condor that was killed on the coast of southern Oregon a number of years ago.

These records seem to show that if the California condor was formerly found in the region of the Columbia River, the numbers have decreased and the last of these northern birds seem to have taken refuge in the rough mountain region of southern Oregon, while the range of the condor in California has contracted to regions from Monterey County south through the mountains of the Coast Range and the extension of the San Bernardino Range into Lower California.

The accompanying photographs were made by Mr. Herman T. Bohlman, who accompanied me in 1906 on an expedition for the purpose of studying and photographing the condor in its native haunts. The splendid pictures herewith published testify to the success of the expedition. In the columns of the current issue of the Scientific American Supplement will be found a more or less detailed account of my observations.

THE LABORATORY OF THE PHYSIOLOGY OF SENSATION AT THE UNIVERSITY OF PARIS.

(*Concluded from page* 6.)

noted. The experiment is then modified by suppressing the lens and receding from the diagram until it again becomes indistinguishable. The pupil is then found to have dilated more or less, according to the character of the object viewed. As the quantity of light received by the eye was the same in each case and only the distance of the object varied, the dilatation of the pupil must have been the result of a cerebral reflex action excited by the idea of distance. In some persons this reflex is related to the acuteness of vision.

For auditory sensations Henry has devised an instrument based on the principle, analogous to the optical principle already mentioned, that the intensity of a sound which reaches the ear through an orifice in a sound-proof screen is proportional to the area of that orifice. Henry's audiometer (Fig. 2) consists of a copper tube divided by a transverse diaphragm into two chambers. Of these, one communicates with a rubber bag which incloses the source of sound (a watch), and the other with a rubber tube which is inserted into the ear. The intensity of the sound perceived can be varied by introducing perforated disks of ebonite between the watch and the diaphragm. In order to prevent the sound reaching the ear through the air or the metal of the tube the rubber bag is made double with an air space between the outer and the inner bag, and the copper tube is lined with cardboard.

The perception of odors is measured with the olfactometer (Fig. 3). This instrument consists of a glass jar containing three concentric tubes, of which the intermediate one is made of paper and the others of glass. Perfume is put into the outer glass tube. The experimenter inserts the upper end of the innermost tube, which is graduated in millimeters, into one of his nostrils, the other nostril being plugged with cotton. He then raises the inner tube with a uniform motion and inhales normally, causing the vapor of the perfume to pass through the paper, enter the inner glass tube and ascend to his nostrils. As soon as the odor is perceived, he stops raising the tube and records its height and the time occupied in the experiment. With these two elements, in combination with certain constant factors, the weight of vapor corresponding to the minimum perceptible sensation is computed.

For the study of sensations of heat, two glass jars, wrapped with flannel, are filled with water at different temperatures. The hands, alternately crossed and not crossed, are plunged into these vessels, the temperature of one of the baths is changed gradually and the smallest difference of temperature that can be perceived is recorded.

Muscular sensations are studied with the aid of dumb-bells to which weights can be added. These dumb-bells are lifted in the usual manner, the maximum effect which can be exerted on the dynamometer being determined before and after each experiment. In this way the fatigue caused by lifting various weights is estimated.

It is impossible, in this brief review, to describe fully the varied work of the laboratory, but mention must be made of a novel process of musical electrification which may prove valuable in therapeutics. The advantages claimed for D'Arsonval's method of electrification by alternating currents of strictly sinusoidal character, over the usual method employing an ordinary induction coil, are well known. In particular, sinusoidal currents are more efficient than ordinary induced currents in increasing internal combustion, without causing pain or violent muscular contraction. Now, as every musical sound, in accordance with Fourier's theorem and the experiments of Helmholtz, may be regarded as the effect of a series of simple sinusoidal vibrations of frequencies proportional to the numbers 1, 2, 3, 4....*n*, Henry thought that interesting results might be obtained by "transforming into alternating currents the melodic and harmonic successions which exert, through the sense of hearing, so varied and profound an influence upon the nervous system." For the realization of this idea he devised the apparatus shown in Fig. 7. The source of electricity is a Gülcher thermopile of 66 elements which furnishes a constant current equivalent to the electrolytic evolution of 170 liters of water gas per hour. The source of sound is a "Polyphone" music box. This is an instrument with interchangeable disks and is remarkable for the uniformity and long continuance (20 minutes) of its action. The velocity of rotation of the disk is measured directly and the pitch of the sound is determined with the aid of resonators. On the sounding board of the music box is placed a Hughes microphone, which is connected in series with the thermopile and the primary circuit of a Bert-D'Arsonval telephone transformer. The currents induced in the secondary circuit of the transformer are introduced into the human body by the electrodes commonly used in electro-therapeutics. The strength of the primary current is controlled by a rheostat. As the microphone performs the function of the interrupter of an ordinary induction coil, the alternating currents which traverse the muscles form, so to speak, a literal translation of the musical phrase, as may be proved by substituting a telephone for the human body. In order to estimate the physiological effects of rhythm and time, a siren producing simple sustained tones is frequently substituted for the music box. Both instruments are placed at a distance, so that the sound cannot be heard by the subject.

A soothing and rhythmical effect is produced by music thus transformed into electricity. A loud sound is felt more strongly than a feeble sound of the same pitch, but high notes have less effect than low notes.

A New Method of Thoracic Surgery.

Prof. Ernest Sauerbruch, of the University of Marburg, Germany, recently read a paper before the surgical section of the American Medical Association, in which he described a new method of performing operations on the organs of the chest without subjecting the patient to possible death by lung collapse. Prof. Sauerbruch performs his operations within a cabinet from which part of the air has been exhausted, the object being to preserve so far as possible the balance between the air pressure in the lungs and that without the body. Normally, the air within the lungs is lighter than the air of the outer atmosphere because of the difference in pressure. When the lungs are exposed, they are subjected to an increased pressure which flattens them, with the result that the patient is exposed to much danger. Prof. Sauerbruch demonstrated the efficiency of his method by operating on a dog. Only the patient's body is confined within the cabinet, so that he may breathe the outer air. The operation is said to have been successfully used in twelve instances.

A celluloid factory in Vienna, Austria, where several hundred persons were employed, was completely wrecked on June 6 by an explosion due either to the ignition of celluloid dust or to the action of some of the powerful chemicals which are used in the process of manufacture. It is known that at least seventeen persons were killed.

Correspondence.

More Curiosities of Numbers.

To the Editor of the SCIENTIFIC AMERICAN:

In the current issue of your valued periodical a correspondent points out that the last figure of the fifth power of any number is always the same as the last figure of the number. By considering the last two figures, however, some much more interesting properties may be brought out. Let us first divide all positive whole numbers into four classes: (1) Odd multiples of 5; (2) even multiples of 5; (3) other odd numbers; and (4) other even numbers. Write down the fourth powers of the first ten or twelve numbers, and it will be seen that fourth powers of class (1) have the last two figures ("two-figure ending") 25, of class (2) the ending 00, of class (3) one of the endings 01, 21, 41, 61, or 81, i. e., 1 preceded by an even number, and class (4) one of the endings 16, 36, 56, 76, or 96, i. e., 6 preceded by an odd number. It is also easily shown that all fourth powers of class (3) are larger by unity than some multiple of 80, i. e., are of the form $1 + 80f$, where f is an integer, and similarly all fourth powers of class (4) are of the form $16 + 80f$. Now raise these formulas to the fifth power by the binomial theorem; since they already represent fourth powers, the answers will give formulas for the twentieth power. It will be found that in each formula every term after the first ends with at least two zeros, and so does not affect the last two figures of the answer. That is, *all* numbers of class (3) and *all* numbers of class (4) have the same two-figure ending at the twentieth power, being respectively 01, and 76; the corresponding endings for classes (1) and (2) are 25 and 00; and no other endings but these four can occur at the twentieth power of any number whatever.

These "two-figure endings" have very many other interesting properties; but I shall not speak further of them here, except to say that some of them have been discovered at very tender ages by some of the mathematical prodigies, and used in mental calculation. They are especially useful in finding by inspection the factors of numbers, or the roots of perfect squares and cubes; and they were so used by Zerah Colburn, for instance, when he was about seven or eight years old, and by other precocious calculators at still earlier ages. In fact, it is just because these curious properties of numbers are so easily discovered by a little practice in mental arithmetic, that so many children have become mathematical prodigies; it is the interest in these numerical properties that stimulates the children to practise counting and calculation until amazing proficiency is attained, at ages when they are not supposed to be able to count beyond ten. Incessant practice in mental counting, stimulated by the constant discovery of these peculiarities of numbers, seems to me to afford the complete explanation of these precocious mental calculators.

FRANK D. MITCHELL.

Ithaca, New York, May 23, 1908.

[P. S. In the current issue, by a typographical error, 8^5 is given as 31,968, instead of 32,768.]

Railway Accidents.

To the Editor of the SCIENTIFIC AMERICAN:

I have read with great interest the communications and other articles relating to railway accidents and their causes, which have appeared recently in your valuable columns. For many years past it has been a matter of wonder to me that with all the ingenuity of appliances which have been devised to improve railroad travel, there is still absolutely nothing, when once a single wheel of a rapidly-moving train leaves the rail, to prevent the whole of that train going headlong and without hope of salvation into the ditch, even though that ditch may be over the side of an embankment fifty feet high. I have noticed that on nearly all bridges I have seen there is a rail running parallel to the track rail, generally a couple of inches outside of it on each side of the track. This I made out to be a guard rail, as I could see no other use for it, and explained its presence on these bridges by supposing that a derailment at those places would necessarily be much more disastrous than at other places, and the absence of such a rail throughout the whole length of the track was evidently due to the expense such a rail would mean. No doubt it would be possible theoretically to build a track that would make it practically impossible for cars to run over an embankment, by providing deep groves or troughs, that the wheels could run in in case they left their proper places upon the rails. This would be very expensive in practice, but it seemed a strange thing to me when I thought of the matter if there were not some way of providing an equivalent of this by a construction of the under side of the cars or trucks upon which cars rest. In looking over some old copies of the SCIENTIFIC AMERICAN, my eye was arrested by the words "Derailment Guard," and looking over the article I discovered that it was even so as I had supposed, that such a device had been invented and patented several years ago. Now, is it not a fact that the Patent Office is full of good devices which are never put into practical use? And is it not also true that this is very often due to the item of expense? But is there any justification in the world for leaving unutilized a system or device which probably would not add more than three or four per cent to the cost of rolling stock, but which might save hundreds of lives annually? I have never seen any practical tests of such a system or device, but I give it as my opinion, as one who has had some practical mechanical experience, that such a system could be worked successfully, and we might see an end to this extraordinary business of having whole trainloads of living human beings going over fifty-foot embankments when even a single wheel or rail fails to do its duty.

I shall be pleased if you will give this letter publicity, and for any information as to what may have been done along this line. CHARLES E. HAND.

Dundas, Ont., Canada, June 15, 1908.

[The Interstate Commerce Commission has recently appointed a board of experts, which is prepared to examine all railway safety appliances which may be submitted to it. The great difficulty presented by devices of the character of those suggested above has been their expense. Their desirability is unquestioned. —ED.]

Lobsters on the Pacific Coast.

BY ARTHUR INKERSLEY.

As the only crustacean found to the north of Point Concepcion, Cal., that has any commercial value is the large crab (*Cancer magister*), the introduction of the common lobster of the North Atlantic coast (*Homarus Americanus*) is highly desirable, for the sake of fishermen and of the public generally. Several attempts have been made to transplant the lobster to the western coasts of the United States, but, so far as can be ascertained, the attempts have been unsuccessful. Since fishermen on the Pacific coast do not employ lobster pots, it is only by accident that they catch lobsters; so that there may be some off the coasts of California, Oregon, and Washington. It is supposed that the waters off the coasts of California and Oregon are too warm for the lobster, which thrives in waters whose temperature varies from freezing point to 60 deg. The average temperature of San Francisco Bay is 51 deg. to 61 deg. F.

The first attempt to plant lobsters in the Pacific Ocean was made in 1873 under the joint auspices of the Federal government and the State of California, the well-known pisciculturist Livingstone Stone having charge of a shipment of 162 lobsters. When Omaha was reached, only forty lobsters were alive, and soon after leaving that place the car was wrecked and the attempt ended. In 1874 the California fish commissioners provided the funds for a second attempt. The lobsters were packed in straw and sponges kept wet and cool by occasional sprinkling with sea water, but only four out of 150 reached the Pacific coast alive. In 1879 a third attempt was made, 22 female lobsters with eggs attached being shipped in three large tanks of sea water in a baggage car. All but one survived, and were planted near Point Bonita, at the entrance to San Francisco Bay. As there were no males, it is believed that the colony did not thrive.

In June, 1888, a large shipment consisting of 250 males, 350 females, and 15,000 loose eggs was made under favorable conditions. They were packed in open trays in loose, moist rock weed kept at a temperature of 42 deg. to 45 deg. The trays were 22 by 18 by 13 inches, of zinc, and were placed in wooden boxes large enough to leave a space of five inches on all sides between the tray and the box, this space being packed with fine ice. On the third, sixth, and ninth days of the journey a quart of sea water was sprinkled over each tray. Under this treatment the lobsters did well, being apparently in perfectly good condition on the eleventh day. A second lot which was wetted with sea water only once in nine days also arrived in good condition. When the shipment reached Sacramento, Cal., it was found that 282 had died. Examinations of the water of San Francisco Bay by Prof. Leslie Lee and Lt.-Com. Z. L. Tucker, commanding the Fish Commission's vessel "Albatross," showed that its salinity is only 1.01988 in the most saline parts, while normal sea water is 1.0274. The waters in the vicinity of San Francisco being considered too fresh, Monterey Bay was decided upon. One hundred and sixty-two lobsters were planted in the bay between Pacific Grove and Monterey in twelve fathoms; 95 were planted in water thirty fathoms deep one mile off Point Lobos, and 30 were taken to a spot 1½ mile off Trinidad lighthouse. The eggs were hatched, 2,000 of the young crustaceans being deposited in San Francisco Bay and the rest in Monterey Bay. Several were placed in a crate in Monterey Bay and became so lively that 45 escaped when the crate was opened for examination. Though their escape was regretted, it was believed that they would do well.

The last attempt to colonize lobsters on the Pacific coast was made in 1906. A large proportion of the lobsters survived the railway journey and were planted in various spots. Though great hopes were entertained of their thriving and multiplying, no satisfactory results were achieved. It was reported several times that lobsters had been seen in shallow water, but it was not certain that the observers were well enough informed to recognize a lobster when they saw one, or to distinguish it from the crayfish called the California spiny or rock lobster, which is not related to the lobster found on the Eastern coast.

Notwithstanding these various disappointments, it is said that the California Fish Commissioners feel satisfied that the Eastern lobster can be acclimatized in Pacific waters. Another shipment will be made after the molting season is over. From 1,000 to 1,200 lobsters will be shipped from Maine in a refrigerator fitted with everything that will make their journey easy and safe. Many of the specimens selected for shipment will have spawn attached to them, and it is expected that millions of young will be liberated soon after they reach the Pacific coast. The lobsters will be packed in wet rock weed, which will be sprinkled every two or three days with sea water. They will be kept at a temperature of 35 deg. to 40 deg., those that die on the trip being thrown out. The journey will be made in a car specially constructed for the transportation of fish, and they will be taken to Puget Sound, where the waters are cooler than off the coast of California, and hold out better hopes for successful culture of the lobster.

The Cowper-Coles Process of Making Tubes and Sheets Directly from the Ore by Electro-deposition.

It has been found impossible to obtain by electro-deposition iron articles such as tubes or sheets of a quality to render them of commercial value and at a cost which compares favorably with ordinary methods at present in use. The chief difficulties encountered have been the slowness of the process due to the necessity of employing a very low current density and in obtaining iron of a quality suitable for commercial purposes. Iron electro-deposited under ordinary conditions is porous and spongy, is difficult to anneal and has a tendency to flake off the cathode during deposition unless deposited at a very low current density, which makes the process and the plant too costly for commercial purposes. The well-known English engineer, Mr. Sherard O. Cowper-Coles, has discovered that iron can be deposited in a form suitable for the production of tubes, sheets, and wire with a bright smooth surface resembling that of very highly polished iron by maintaining the solution from which the iron is deposited charged with iron oxide.

In a suitable way of carrying out the invention the iron oxide is kept in suspension in the electrolyte by means of stirrers or by moving one or both of the electrodes or by any other suitable means, the effect of which is to reduce the acidity and effect a burnishing action on the iron deposited. Excellent results have been obtained from a solution containing 20 per cent of sulpho-cresylic acid saturated with iron, the current density being 100 amperes per square foot of cathode surface, the voltage 3.25 at the terminals of the iron electrodes, these being ½ inch apart and the temperature of the electrolyte 70 deg. C. The temperature of the electrolyte considerably affects the quality of the iron. If it is much below 70 deg. C. the iron becomes laminated and flakes off; if it is much above 70 deg. C. the surface becomes covered with ridges or stream lines and cannot be used for commercial purposes without further treatment.

Iron produced from the sulpho-cresylic solution is exceedingly hard and when it is desired to produce soft tough iron, ferrous sulphate solution should be employed.

Iron articles produced as described are said not to pit or corrode like iron which has been cast or wrought into the desired form. This is probably due to the purity and uniformity of the metal.

When steel articles are to be produced carbon is deposited with the iron and after removal from the mandrel they are heated to a high temperature to convert the iron into steel.

It is well known that potassium-sodium alloy and the alkali metals generally sealed up *in vacuo* exhibit marked photoelectric effects permitting the escape of negative electricity but not positive when the surface of the metal is illuminated. In an experiment made by Dr. J. A. Fleming before the Royal Society a sample of such alloy was prepared for this purpose. The alloy was inclosed with an insulated platinum plate in an exhausted tube. When illuminated by an arc lamp negative electricity supplied by a battery leaked from the surface, and by the interposition of colored films of gelatine and glass it was shown that the leak was due to the most refrangible rays of the spectrum. The effect of polarizing the light in various planes was also exhibited.

THE GREAT ROOSEVELT IRRIGATION DAM.

BY DAY ALLEN WILLEY.

The irrigation dam in construction on the Salt River in eastern Arizona is one of the greatest projects of its kind which has been as yet undertaken by the United States Board of Reclamation. The Roosevelt dam, which is to create the Tonto reservoir, will be with one exception the highest constructed by the Board's engineers, while exceeding all other of their works in other capacities. The dam, of which preliminary information was given in a previous issue,* will form a storage basin holding sufficient water to flood 1,300,000 acres to an average depth of one foot. This quantity is much larger than the volume held in storage by the greatest Nile reservoir. The supply will be secured from the Verde and the Salt rivers, which drain a watershed of 6,260 square miles. The average yearly rainfall over this drainage basin is not over 20 inches. The annual rainfall upon the territory to be irrigated ranges from 3 to 10 inches; and the rapid evaporation of moisture is indicated by the fact that the temperature in summer ranges as high as 120 degrees, although the elevation varies from 1,000 to 1,300 feet altitude. The dam will impound sufficient water to fully irrigate 270,000 acres of soil. This soil is known to be fertile when water in sufficient quantities is applied; the Department of Agriculture having tested a few experimental tracts, with the result that the crops have been remarkable for their quality and yield.

A feature of the undertaking is the power canal. Water power or electric current has before been secured from dams intended for irrigating purposes by utilizing the waste water. Such power, however, is only available when the flow of water into a reservoir is more than sufficient to fill it. The power at Roosevelt is obtained independently of the irrigating scheme, the canal being separate from the reservoir and one of the first works completed. The head of water secured by means of the canal actuates waterwheels connected to electric generators at present developing over 1,500 horse-power. From the power station extends a transmission line conveying current to the plant for the manufacture of cement, the stone-crushing plant, for lighting, operating the aerial railway, and for other purposes. Under a head of 250 feet, hydraulic jets with nozzles of 11 inches have been used to wash away the loose formation and accumulation of sump above the bedrock upon which the dam proper is being built, and have greatly facilitated progress. Much of the gravel thus secured has been utilized for construction material. To remove the gravel, elevators have been placed in service.

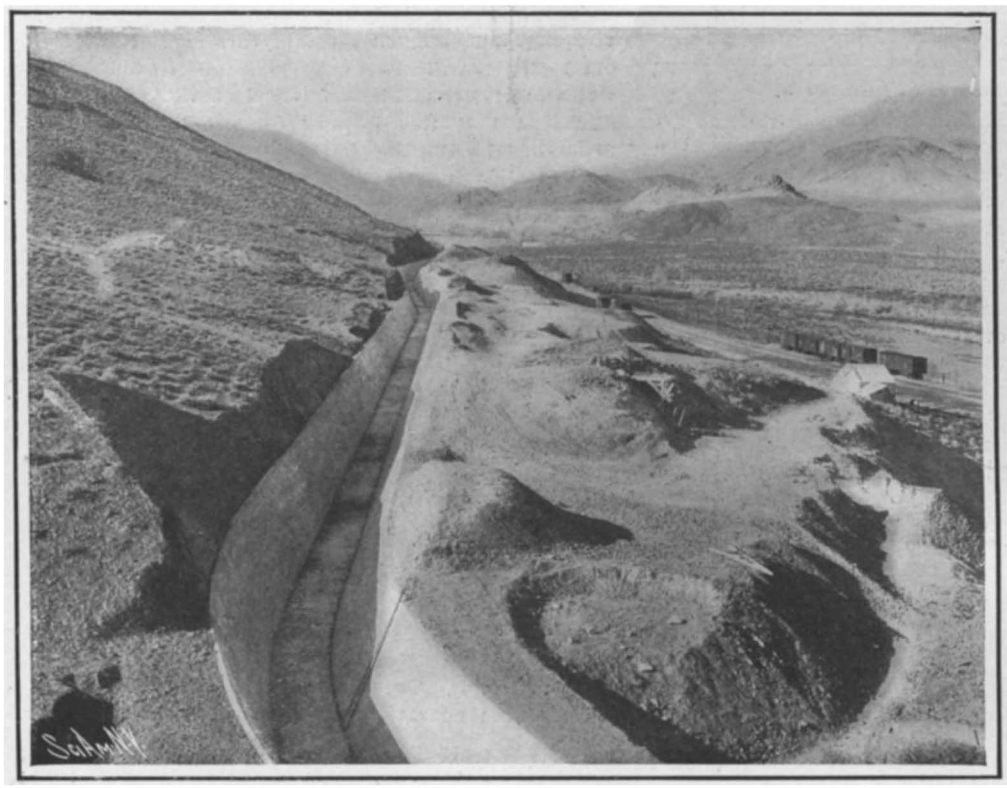
This canal, which is twenty miles in length, is one of the permanent works. Most of it is lined with concrete, and it includes several extensive tunnels, aggregating nearly 10,000 feet in length. It is carried over gulches by concrete pipes. The dams used for diverting the water to the power canal represent a cost of $40,000, while the canal, including its pressure pipe and auxiliary structures, represents a total of nearly $1,000,000. When all of the generating sets to be installed are in service, it will develop no less than 4,400 horse-power, which will be used for pumping water for irrigation.

A cement mill has a capacity for manufacturing 10,000 barrels a month when the machinery is working to its complete capacity. Much of the raw material necessary for cement has been found in abundance locally, and cement is manufactured at a cost of $2.25 per barrel, less than half the cost of cement from the outside. The mill is operated entirely by electric power, as already intimated, the current being transmitted from the power house at the end of the canal.

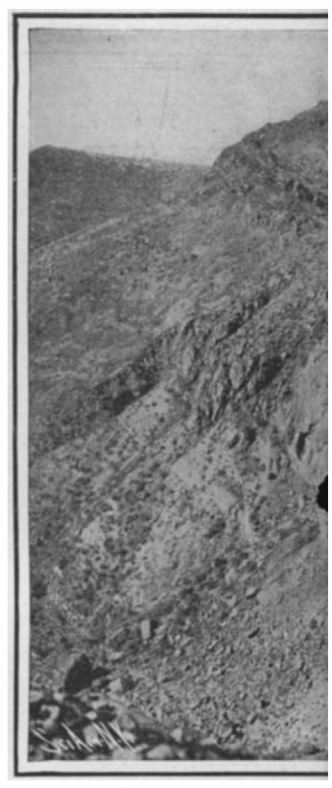
Work upon the construction of the dam proper has been in progress only since September 20, 1906, owing to the immense amount of labor required in making the excavations to bedrock. When it is remembered that the height of the dam above the rock is 284 feet, the length at the bottom 235 feet, and the length at the top 1,080 feet, the time and labor required in preparing the site for the wall do not seem excessive. The work is what is technically known as a masonry arch dam with a gravity section arising from the foundation. It will range in thickness from nearly 175 feet at the bottom to 16 feet at the top—sufficient to provide a highway for vehicles.

As soon as the blocks of stone are quarried, they are carried to the site and placed in position by boom derricks, while the aerial tramway conveys the cement in which they are set. An enormous quantity of rock, set in concrete, is required for filling in behind the face, and bowlders as large as can be handled are used. Nearly 400,000 cubic yards of masonry will be placed in position when the dam is completed, and the reservoir which it will create will form a lake 25½ square miles in area. As soon as the dam is finished, the cement mill and other construction plants will be stripped of all machinery which can be profitably removed, and the buildings abandoned, as they will be many feet under water when the reservoir fills.

* SCIENTIFIC AMERICAN, December 16, 1905.



An Open Section of the Power Canal.



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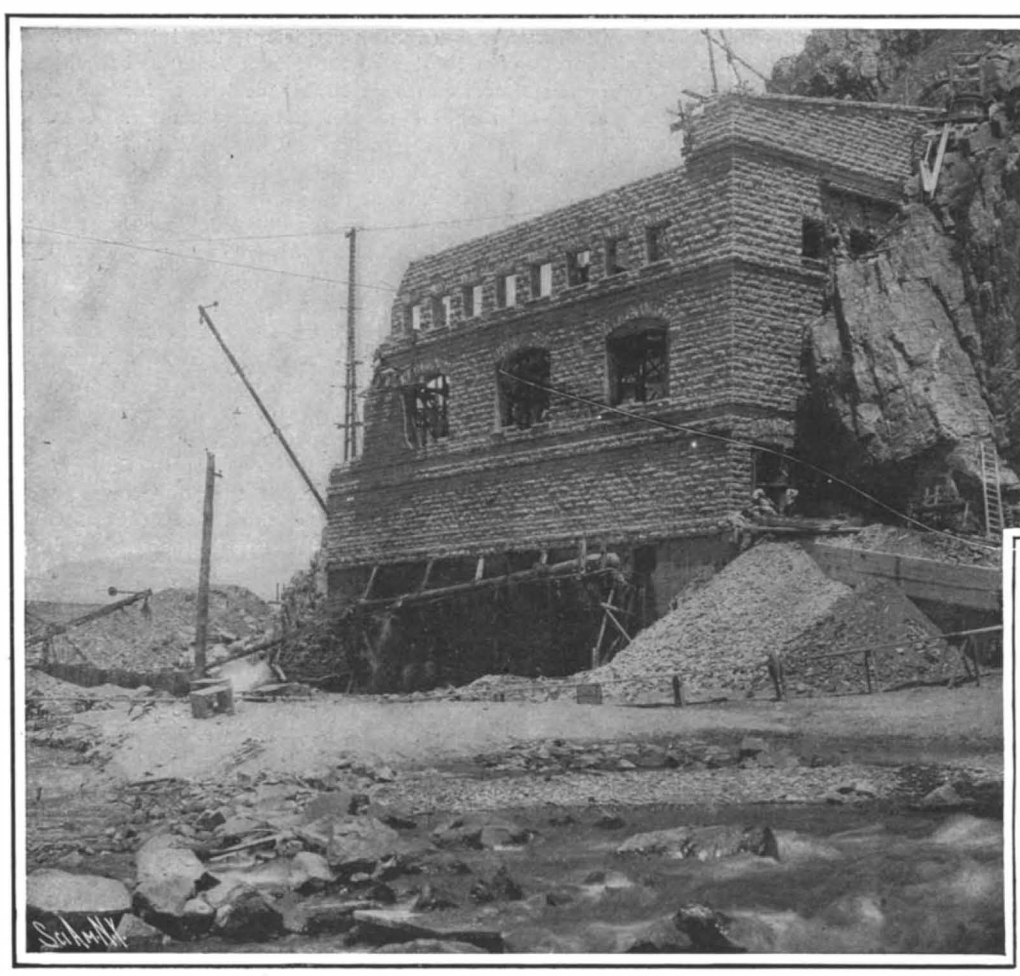
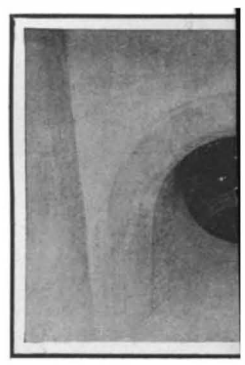


The Permanent Power Station Which Will Furnish Power for the Irrigating Pumps.



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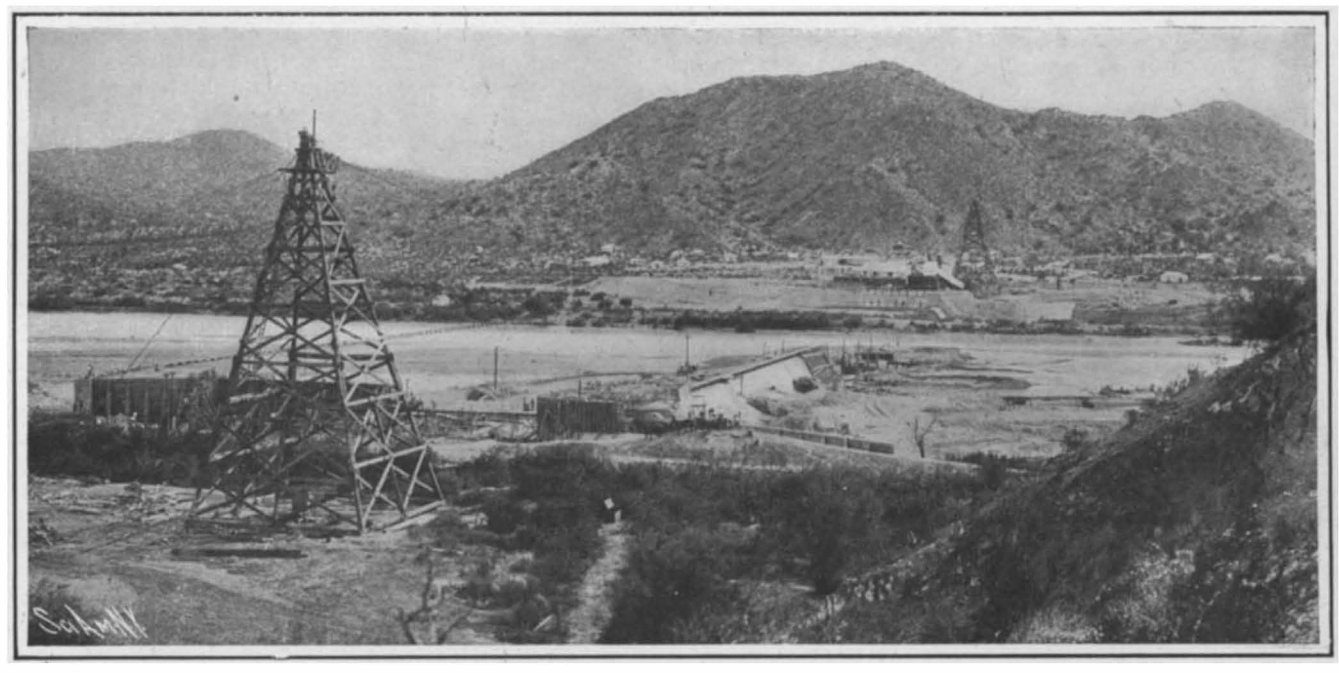
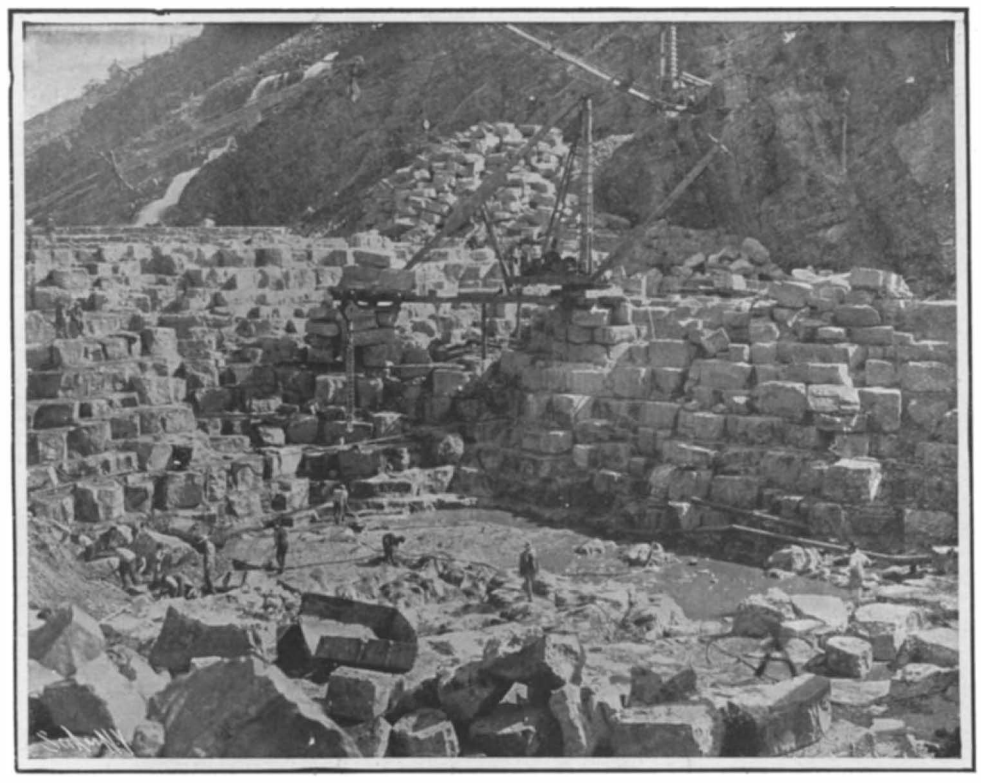


A General View of the Granite Reef Diversion Dam.



The Stones of the Dam; Their Great Size is Indicated by the Men at Work.

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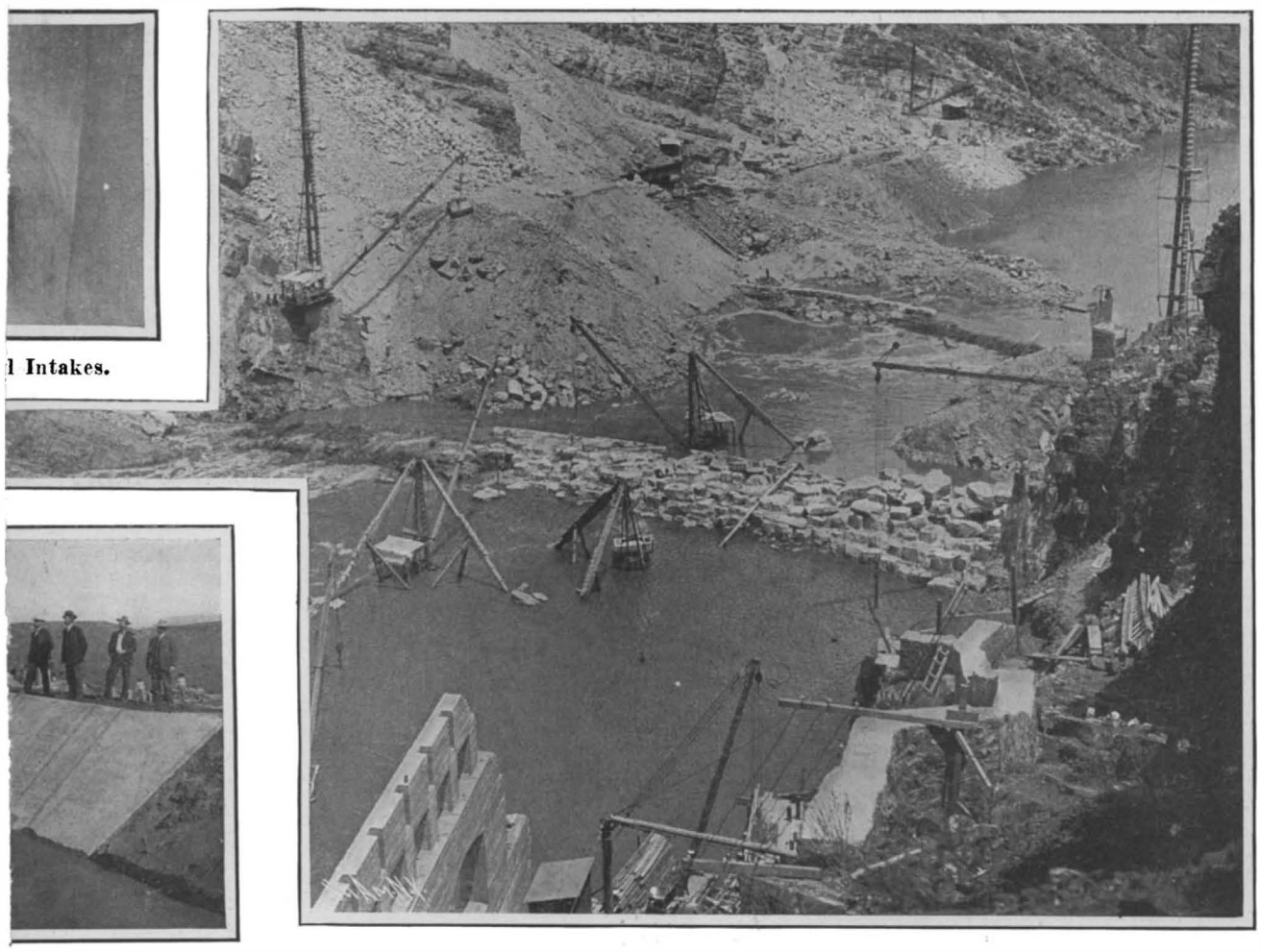
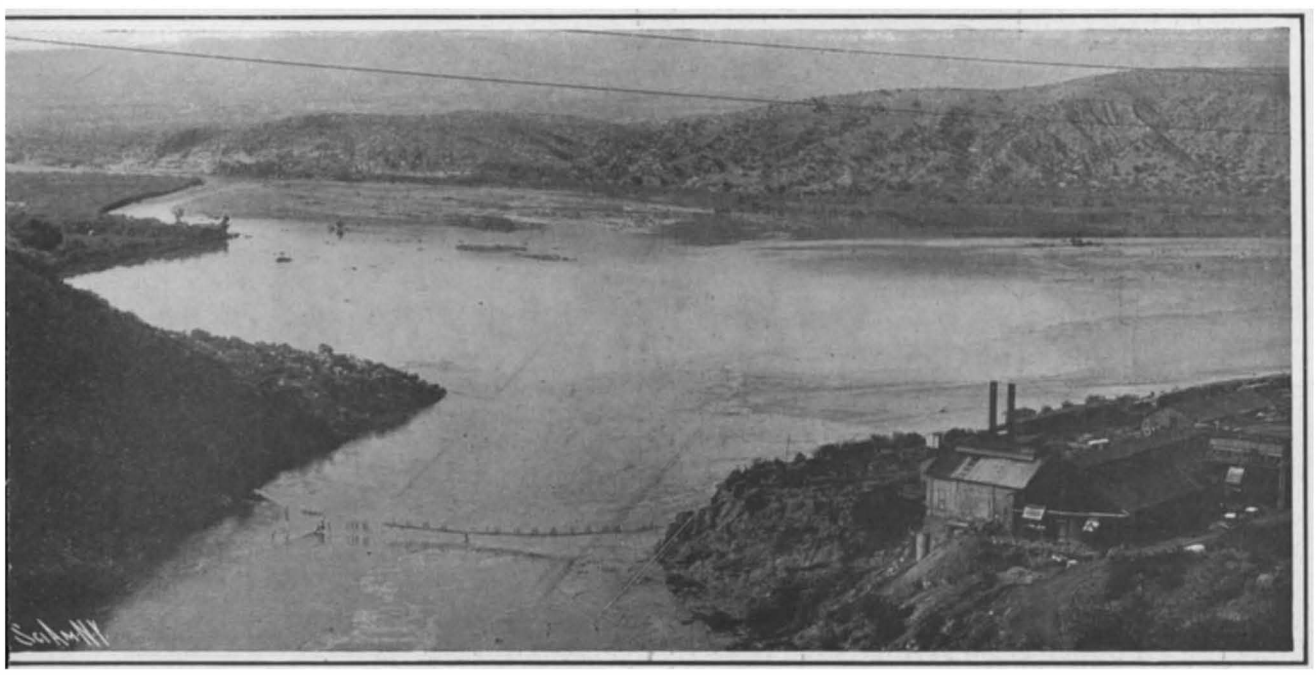


Power Canal.

The Dam as Seen from Above the Power House.



The Stream to be Impounded; a View in Flood Time.

RIGATION CANAL.

An interesting feature of the work is an outlet, which has been constructed through the walls of the canyon a distance of 500 feet. This tunnel will not only carry off much of the surplus water, but also the silt which is brought down the channels in such large quantities during flood height. The question of removing this silt was solved by the engineers by planning the tunnel in question. The current through it will be so rapid, that it is believed the sediment will thus be removed without difficulty. The tunnel contains no less than six gates, which will be required to regulate the flow of the water. They are built to be operated under a pressure of 100 pounds to the square inch, and including their operating mechanism will weigh in the aggregate nearly 400 tons.

Considering the extent of the project, rapid progress has been made. On June 1 of last year but three per cent of the construction had been completed. At the end of 1907, however, the great wall had reached a point nearly 20 feet above its base and extending from side to side of the canyon. This work has been accomplished in a climate where the temperature reaches 120 deg., and operations have been carried on during the intense heat of the summer.

The diversion dam to be constructed 30 miles from the main dam is almost as important in connection with the reclamation of this section of Arizona as the construction at Roosevelt. Work has been in progress upon this for over a year. It is intended to keep the water of the Salt and Verde rivers at a certain level, and will increase their depth to the extent of 15 feet over the present low-water average. An idea of the dimensions of this dam can be gained when it is stated that it will be nearly 1,300 feet long, and will require 40,000 cubic yards of concrete before it is completed. A distributing canal is being built in connection with regulating gates, which will have a flow of at least 2,000 feet per second. This is located upon the north side of the dam. Another canal with the capacity of 1,000 feet per second is being constructed on the south side. The site of this operation is at what is known as Granite Reef, about thirty miles from Phœnix. It will furnish the water which will be served by the electric pumps already referred to, the service covering 40,000 acres.

The Electrolytic Purification of Sewage.

The installation has just been completed at Santa Monica, Cal., of the first electric plant for the purification of sewage to be erected in the United States. The system is known as the Harris magneto-electrolytic process. It will be ready for operation just as soon as the necessary outfall pipes can be laid. The plant consists of two wooden tanks, each thirty feet long, two feet wide, and eighteen inches deep. Each tank is equipped with ten sets of electrodes and ten electromagnets weighing three hundred pounds each. The electrodes are fitted with steam pipes for use in cleansing them. The electric energy is supplied by a direct-current generator of special construction, equipped with a motor and separate exciter. A generator of this pattern is required to obtain perfect results, as the requisite is low voltage and high amperage, in opposition to the requirements for power and light.

The plant is located in a concrete chamber which is equipped with two compartments sealed tight, into which the sewage is pumped from the receiving basin. The purpose of these chambers is to secure an equalized flow through the electric tanks, and their combined capacity is one million gallons per day. After leaving these sealed chambers, or forebays, the sewage is allowed to flow into the tanks in sufficient volume to cover the electrodes and the magnets to a depth of three inches. The current is turned on as the sewage flows steadily over the wires and enters the outfall pipe. By that time it is supposed to be odorless and perfectly harmless.

What actually happens as the sewage passes through these charged tanks has not been scientifically determined; but experience has demonstrated that as the electric energy required for the operation of the plant is held, the effect is to immediately release the hydrogen, and as it leaves the water the oxygen is released. The constituents of water being oxygen and hydrogen, the releasing of the latter precipitates all of the inorganic matter, and the releasing of the former forms an ozone, which is responsible for the burning or oxidation of the organic matter. The result is that the sewage becomes immediately purified, and if passed through sand or other filter appears as pure sparkling water.

Experiments have demonstrated that the cost of the electric energy required for the operation of the plant will not be in excess of fifty cents for each million gallons treated. The plant is being installed by C. P. Chandler and L. G. Lautzenheiser, who have contracted to operate it during a period of sixty days to the satisfaction of the city council. At the end of that test period, should the system prove to be a success, the city will purchase the plant, the approximate cost of which is $12,000.

THE GERMAN BATTLESHIP "BRAUNSCHWEIG."

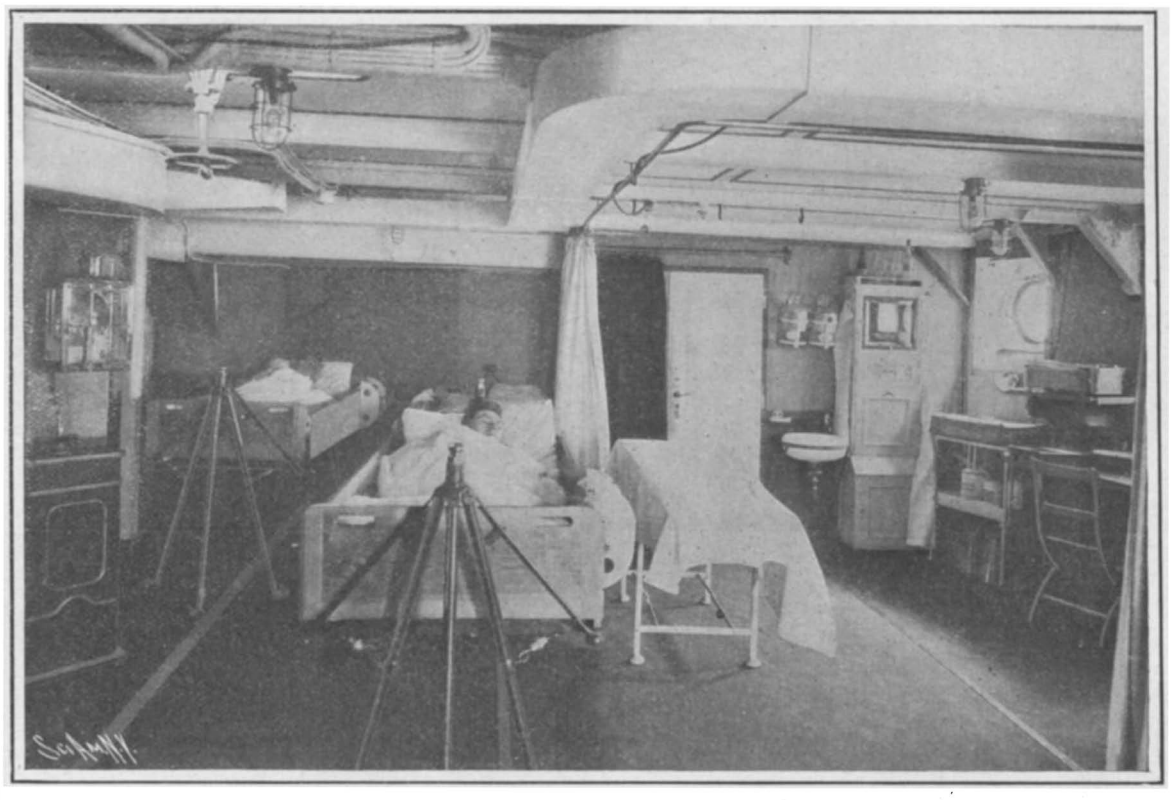
BY FRANK C. PERKINS.

There is no doubt that the German warships are, in workmanship and efficiency, the equal of any in the world. In design they are what might be called strictly conventional. The later battleships are of the standard type, whose genesis may be said to date from the appearance of the ships of the "Royal Sovereign" class of the British navy. The distinguishing type features are the mounting of four heavy guns in turrets, one forward and one aft, supplemented by a numerous secondary battery of guns of 6-inch caliber, distributed either in a central casemate redoubt or emplaced in secondary turrets.

The "Braunschweig" is one of a class of five vessels completed between the years 1904 and 1906. The others are the "Hessen," "Preussen," "Elsass," and "Lothringen." She measures 410 feet on the waterline, 72 feet in breadth, and her mean draft is 25¾ feet. Over all the vessel measures 430 feet. She has an ample freeboard of about 20 feet throughout her entire length. The waterline is protected by a continuous belt of armor, increasing in thickness from 4 inches at the ends to 9 inches amidships. Associated with this is a 3-inch protective deck, which slopes at the sides to a junction with the lower edge of the waterline belt.

The 11-inch guns are mounted in turrets of 11-inch armor, above barbettes of the same armor thickness. Between the main barbettes, the lower deck is protected by 5 inches of armor, and the main deck by 6 inches. The 6-inch armor wall is pierced by ten casemates, five on each beam, in which are emplaced ten 6.7-inch 40-caliber guns. On either beam, also, are two small turrets protected by 6¾ inches of armor, in each of which is emplaced a 6.7-inch gun. For protection against torpedo-boat attack the ship carries twelve 24-pounder guns of 3.4-inch caliber. Forward, and firing through the forefoot of the vessel, is a submerged 17.7-inch torpedo tube, and there are two other submerged tubes of the same caliber on either side below the waterline. Astern is a sixth torpedo tube, mounted 2 feet above the waterline. All of the guns have electric hoists. The big guns are maneuvered by hydraulic, electric, and hand gears, and the guns of the secondary battery by both hand and electric gear.

The ship is propelled by three sets of three-cylinder vertical triple-expansion engines, driving three propellers. The designed horse-power for a speed of 18 knots is 16,000. The "Braunschweig" carries a normal supply of 700 tons of coal, and a maximum supply of 1,600 tons. Two hundred tons of oil, also, are carried in the double bottom. The radius of the vessel is 5,500 miles at 10 knots. She can do about 3,000 miles at 17 knots, and over 2,000 at her full speed of 18 knots an hour. The equipment throughout is of the highest class, and, as illustrating this, we present a view of the interior of the sick bay, showing the swinging cots, the excellent means of ventilation, and the sanitary furnishings.

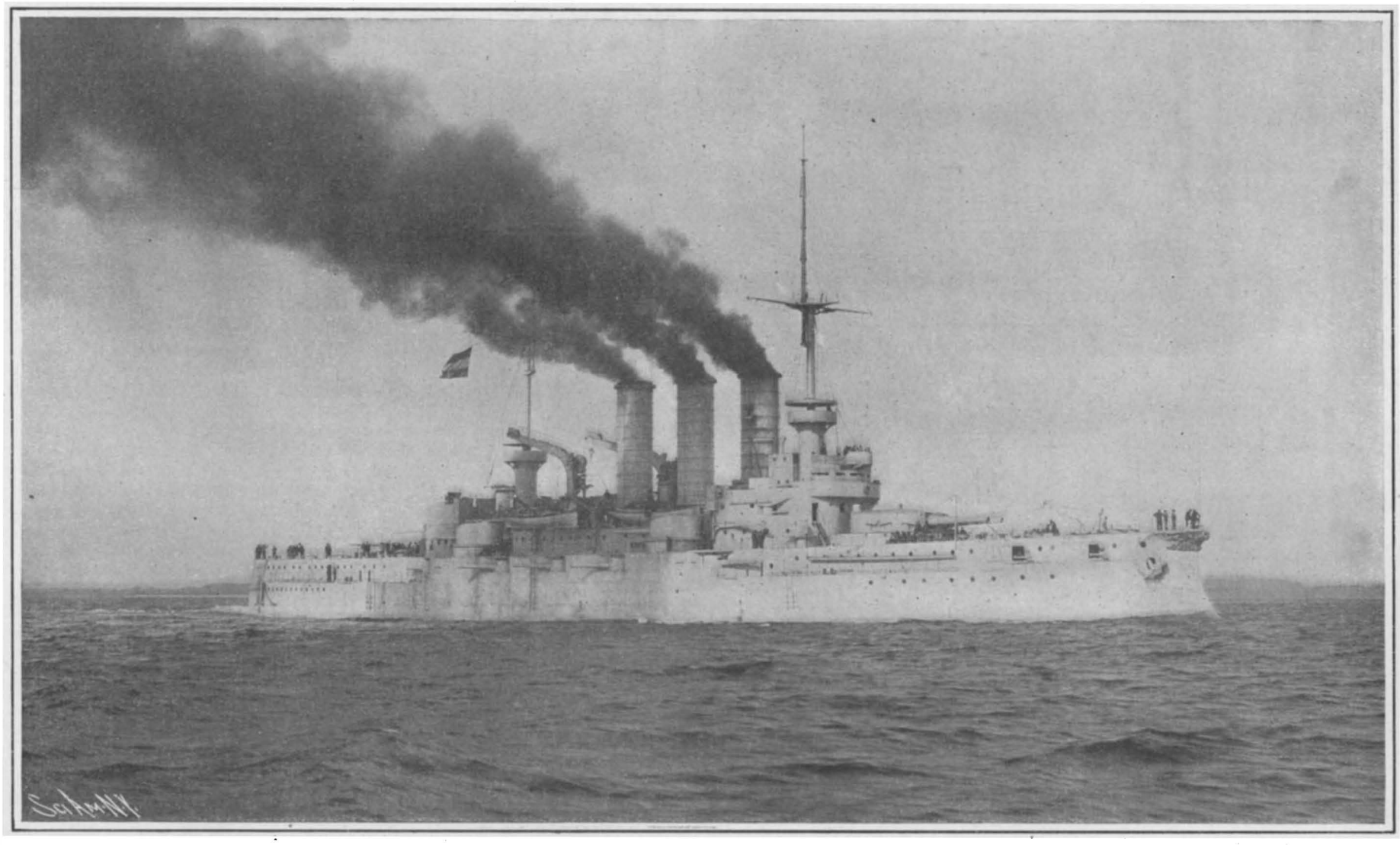


Sick Bay on the German Battleship "Braunschweig," Showing the Swinging Cots.

Preservation of Anatomical Specimens.

According to the researches of G. Fornario, anatomical specimens can be preserved in alcohol without losing their color, provided the specimens are given a previous treatment, according to the author's process. Other methods which have been brought out for this purpose appear to modify the histologic structure and also the reactions with certain coloring substances, and besides their use is expensive from the large amount of glycerine which enters into their composition. M. Fornario had occasion to observe that specimens which had been preserved in formol and had lost all of their color, would take a bright color and almost like that of a fresh specimen when they were placed for a short time in a solution of picric acid to which acetic acid is added. He finally arrived at the following method of treatment: The specimens, not washed, or washed in a 0.7½ per cent salt solution, are placed in a ¼ per cent solution of commercial formol, and after 48 hours they are placed in 90-deg. alcohol for 24 hours. One-half of this time will answer in the case of small animals or fragments of organs. Then the piece is placed in fresh 90-deg. alcohol, into which is dropped a variable quantity of a solution composed of 100 parts saturated solution of picric acid and 4 parts concentrated acetic acid. The primitive color of the specimen reappears in a few minutes. The quantity of the latter solution to be added depends on the size and thickness of the piece, and does not exceed one per cent. In this solution the specimens can be kept indefinitely, but it is better to take them out after a few days and preserve them finally in strong alcohol. The color remains bright and does not seem to be modified with time.

The record of muscular strength was held until recently by two professional athletes, named Viard and Empain, who lifted with one arm weights respectively of 244 and 250 kilogrammes (about 538 and 551 pounds). This record has now been surpassed by a M. Verhaert, not a professional athlete, but the director of a Belgian glass factory, who raised a weight of 253 kilogrammes (about 558 pounds).



Displacement, 13,200 tons. **Speed,** 18.5 knots. **Coal Supply,** 1,600 tons and 200 tons oil. **Armor:** Belt, 9 inches; barbettes, 11 inches; central battery, 6 inches. **Guns:** Four 40-caliber, 11 inch; fourteen 6.7-inch; twelve 24-pounders; twelve 1-pounders. **Torpedo Tubes,** 5 submerged, 1 above water. **Date of Completion,** 1904.

GERMAN BATTLESHIP "BRAUNSCHWEIG."

THE "JUNE BUG" AEROPLANE—A COMPETITOR FOR THE SCIENTIFIC AMERICAN TROPHY.

About two months ago we illustrated the second aeroplane to be produced by Dr. Bell's Aerial Experiment Association. This machine made a number of successful flights, the longest of which was made with Mr. G. H. Curtiss acting as aviator, and in the course of which a distance of 1,017 feet was covered. The chief novelty of the second machine consisted in the application of movable triangular tips to the ends of the arched aeroplane surfaces. These tips were pivoted on their forward edge and connected by a cord to the body of the aviator, so that, when making a turn, by inclining his body toward the center of the circle, he would give the inner tips a greater angle, and thus tend to turn the machine by making more resistance at the inner end. The aeroplane had pneumatic-tired wheels and was fitted with a horizontal rudder in front in a similar manner to most of the foreign aeroplanes. It was also fitted with a rectangular box tail which, however, was much smaller than the tails ordinarily used on the Farman and Delagrange aeroplanes. The motor—an 8-cylinder air-cooled Curtiss—was mounted in the center of the aeroplane just back of the aviator, and it carried a six-foot propeller on the rear end of its crankshaft. This second aeroplane was demolished when a flight was attempted in it by one of the members of the association. The construction of a third machine was immediately started. This was recently completed, experiments having been made with it last week.

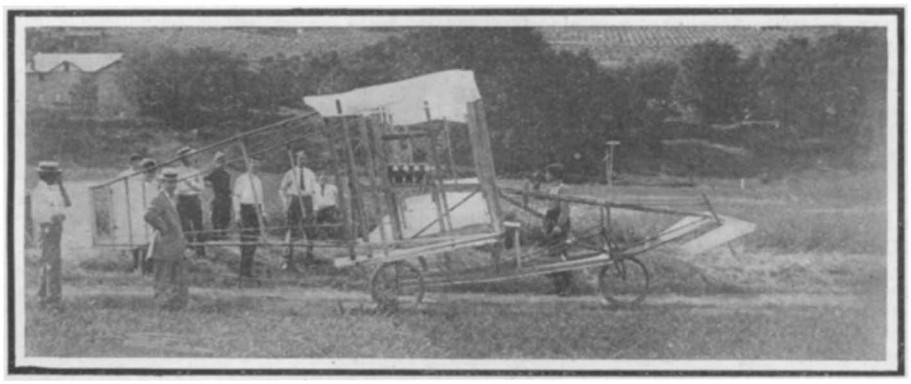
Our illustrations show this machine on the ground and when in flight. The changes which have been made in the general outline and design are few, the chief of these being the fitting of a rather smaller tail and the arching of the surfaces of this tail from end to end in the same manner as was done with the main surfaces. Another new point in the design is the construction of the surfaces so that they can readily be detached from the main central chassis, a view of which is shown in one of the illustrations. The forwardly-projecting members of this chassis are no longer covered with cloth. They simply form a bamboo skeleton frame which supports the horizontal rudder. This rudder is cut away in the center so that it can move on either side of the frame. A long rod is attached to its forward edge at right angles to the surface of the rudder and connected by wires to a lever for the purpose of operating it. A steering wheel is used for working the vertical rudder in the tail at the rear, while the movable tips connected with the aviator also assist in steering.

After several preliminary flights ranging from 456 to 1,266 feet, the aeroplane, which has been christened the "June Bug," on June 25 made the two longest flights that have ever been publicly accomplished by a heavier-than-air flying machine in America at any accessible place. These flights were both in a nearly straight line. The distance covered in the first flight, which was made in the morning, was 2,175 feet in forty-one seconds. This corresponds to a speed of 36.17 miles an hour. In this test, the aeroplane rose to a height estimated at about 40 feet, which is quite a considerable height for one of these machines, being about four times as high as they usually fly abroad.

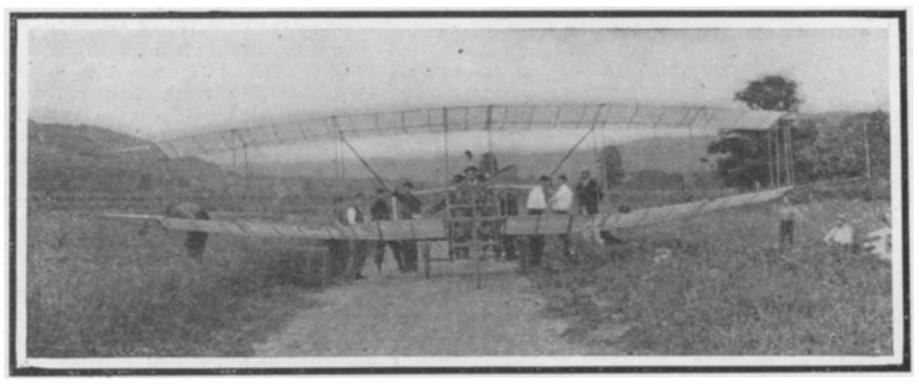
In the afternoon, another flight was made with Mr. Curtiss again acting as aviator. In this, the seventh flight the machine had made, and the eighth time Mr. Curtiss had been in the air in an aeroplane, a distance of 3,420 feet was covered in a slightly-curved course in exactly one minute. This is a rate of speed of 38.86 miles an hour. Thus, in his eighth flight and his second or third attempt at flying a kilometer (3,280 feet) in a straight line (which is the distance required in the first contest for the SCIENTIFIC AMERICAN trophy), Mr. Curtiss succeeded in covering 140 feet more than the required distance over a slightly curved course, which certainly speaks well for the machine and for its aviator. Notice has been filed with the Aero Club of America for a trial for the trophy. The Fourth of July and Hammondsport, N. Y., have been appointed as the time and place for the trial. It is to be hoped, also, that this machine will be developed sufficiently so that it can fly in competition with Delagrange and the Wright and Herring aeroplanes in August, when it is proposed to have a competition for the trophy either in the vicinity of New York or Washington.

As we have no particulars of the conditions under which these two long flights were made, we can only say that according to report the aeroplane surfaces were thoroughly varnished and made airtight before the flights were attempted, and that this varnishing of the surfaces increased the lifting capacity of the aeroplane and made it possible to fly with less power than had been required hitherto. In the first long flight the machine is said to have tipped sharply to one side shortly after it rose in the air, but the aviator was able to right it again by means of the movable wing tips, and from then on he managed to keep it level. No difficulty was had in rising from the ground after running along on it a distance of about 100 feet.

The center part, or chassis, of the aeroplane, which is shown in one of our photographs, developed a speed of 45 miles an hour when driven along the road by the air propeller. The construction of the machine in this manner is a great advantage, since it can readily be taken apart and packed for transportation when desired.



Side View of the "June Bug" Aeroplane.



Front View, Showing Movable Wing Tips.

AN AERONAUTIC SOCIETY FOR INVENTORS.

A new society to be known as "The Aeronautic Society" has just been incorporated in New York State for the purpose of exploiting aeronautics in general and the heavier-than-air flying machine in particular. This society will take the place of the Aviation Section, which the Aero Club of America started to form last spring, but which was subsequently dropped. The main idea of this new society is to help the worthy inventors to try out their ideas in a practical way. It is proposed to have a suitable ground within a convenient distance of New York city where experiments in aviation can be made; to furnish a gasoline motor for the conducting of such experiments; and to aid the members of the society in every way possible to test their ideas. Full particulars can be had from the Secretary of the Society, at 2 E. 29th Street, New York.

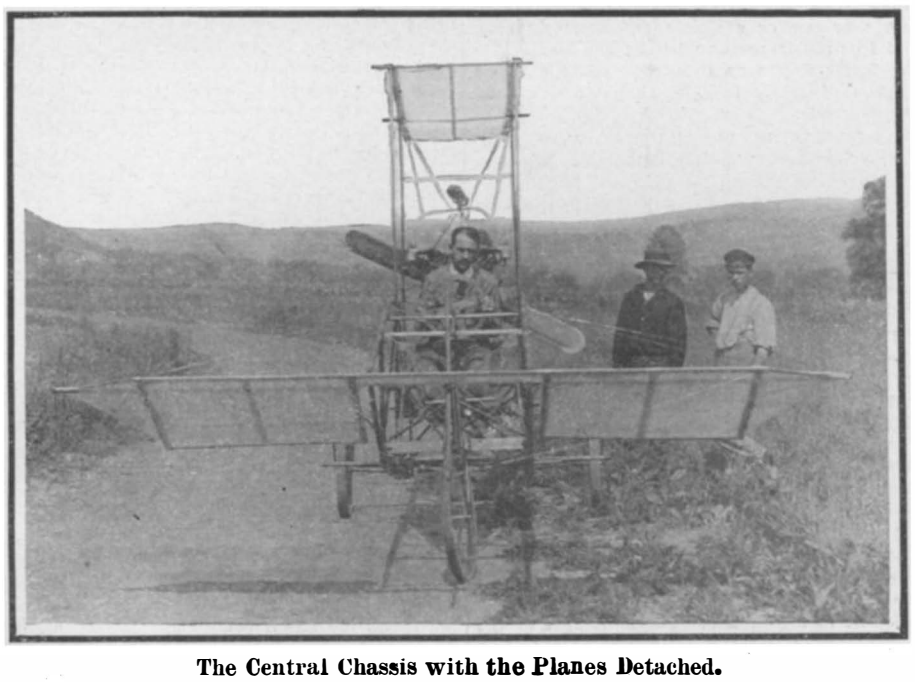
The society expects to bring Leon Delagrange to America, about the 20th of August, and to have him make a series of flights in the vicinity of New York. It is believed that this will stimulate aviation to a great extent in this country.

Aeronautical Notes.

On June 22, at Milan, Italy, M. Delagrange circled nine times around the Piazza d'Armi in 16½ minutes. The distance covered was 9½ miles, and the rate of speed 34½ miles an hour. The following day he remained in the air 18 minutes, but touched the ground slightly while making one of the rounds. After some further flights at Turin, it is expected that he will visit America.

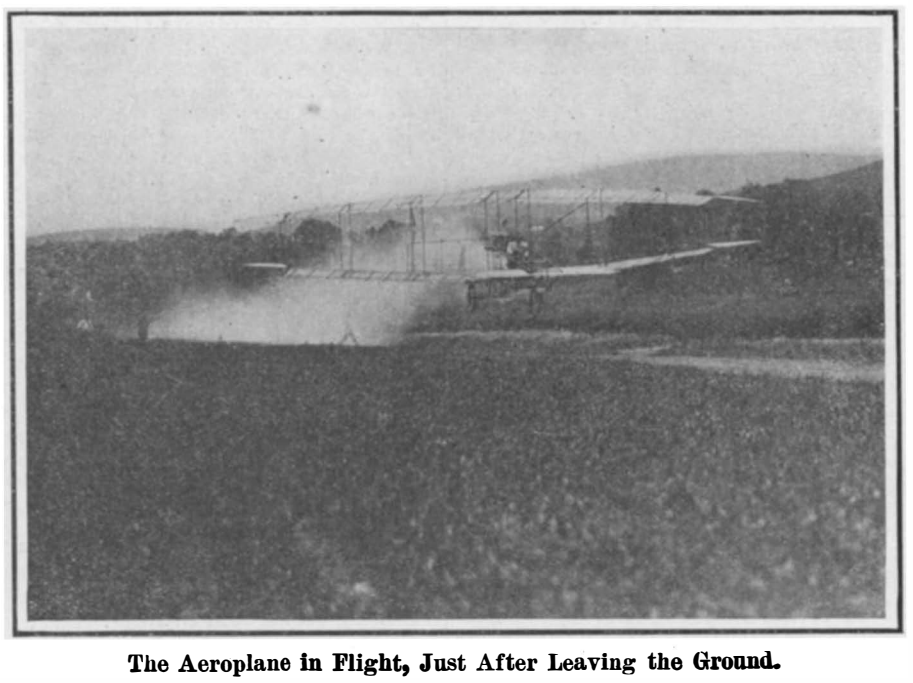
The huge new Zeppelin airship, which is 426 feet long and 43 feet in diameter, and which has an envelope constructed of thin sheet aluminium stretched upon a rigid framework, made a successful trial trip on June 23, for the purpose of testing its new steering gear. The airship remained in the air 2 hours and 13 minutes, maneuvering above Lake Constance and several of the towns on its shore. The steering apparatus worked perfectly, and Count Zeppelin was quite satisfied with it. After a few more tests have been made, it is expected to make a long flight.

The new 328-foot French military dirigible "La Republique" made its first flight on the 24th ultimo. The flight lasted 35 minutes. The airship traveled at a height of some 300 feet, and carried a dead weight of 2,800 pounds.



The Central Chassis with the Planes Detached.

The horizontal rudder is carried on a forwardly-projecting bamboo frame. The motor and propeller are back of the aviator. The center part of the upper plane is seen at the top.



The Aeroplane in Flight, Just After Leaving the Ground.

Note the cloud of dust raised by the machine; also its apparent stability.

THE "JUNE BUG"—THE THIRD AEROPLANE OF THE AERIAL EXPERIMENT ASSOCIATION.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SHOE-SOLE ATTACHMENT.—J. F. MITCHELL, Topeka, Kan. The invention embodies in its construction both an instep support and a spring heel, the same being designed to neatly conform to the under surface of the foot, whereby the pressure brought to bear thereon will be substantially uniformly distributed.

COLLAR-SUPPORT. — M. J. TOPP, New York, N. Y. Mr. Topp's invention relates to collar supports and the like, his more particular object being the production of a type of stay for the purpose of stiffening the collar. It further relates to means whereby the stay is rendered more easily extensible.

Electrical Devices.

SPARK-PLUG PROTECTOR.—C. H. STUART, Newark, N. Y. The object in this case is to provide improved means for protecting spark plugs on internal combustion engines from rain, spray, or moisture which would tend to short circuit and prevent a proper spark. It is especially useful in connection with spark plugs used in boats, automobiles, and in other exposed positions.

Of Interest to Farmers.

CATTLE-GUARD.—E. J. YORK, Houston, Tex. One purpose here is to provide a guard that can be readily and quickly applied to any track, and which does not require in its application any extra timbers, ties, or excavation, and further to so construct the guard that it can be easily dismantled and replaced when the track is to be repaired.

PLOW.—W. H. GOLDTRAP, Cotulla, Tex. This plow is for use more particularly in growing onions and other vegetables, and the like. The wheels are adjustable to the width of the rows to be plowed, and the contrivance presents handles by means of which the plowshares can be moved into inoperative positions.

BEET-HARVESTER. — C. M. MCCORMICK, La Junta, Colo. The harvester is particularly of use in removing the tops from the roots, dig the latter from the ground, and convey them to a hopper whence they are removed to a wagon or the like. The object of the inventor is to provide a harvester, which is provided with an efficient plow for digging the roots without injury thereto.

Of General Interest.

TURPENTINE-SCRAPER.—G. S. PETTEWAY and L. W. DUVAL, Ocala, Fla. The object of the improvement is the provision of means for scraping pine trees in order to secure the accumulated resin and pitch, and to avoid the loss resulting from the scattering of the material on the ground. The construction can be cheaply made.

TRUNK.—W. G. WINANS, Spokane, Wash. In the use of the ordinary trunks, it is necessary to provide trunks of different sizes for different purposes. By Mr. Winans's improvement any number of sections may be employed, and the immediate sections supplied as necessary, or the top and bottom sections may be united directly when a small trunk is desired.

REINFORCING-BAR.—G. N. WILSON, Philadelphia, Pa. The bar is imbedded in concrete for the purpose of strengthening the same. If made of steel or iron, its coefficient of expansion is substantially the same as that of concrete. Various bent portions present either concave or convex surfaces. Inasmuch as there are a plurality of projecting portions both toward and from the axial center of the bar, and these are alternated with the strengthening portions, displacement of the bar in any direction is impossible.

EXPANSION-BIT.—C. A. BUTLER, Bartlesville, Okla. The bit is more especially designed for drilling oil and artesian wells, and the inventor's object primarily is to provide a bit which is adapted to drill a hole of sufficient diameter at a single operation for receiving the well casing, and to permit of the latter being inserted in the hole as the drilling proceeds.

ENVELOP.—C. B. STILLWELL, Jacksonville, Fla. More particularly the invention relates to a construction adapted to facilitate the opening of the envelop after it has been sealed. The envelop is so constructed as to present a tab by means of which an opening may be torn in the envelop sufficiently large to permit the ready insertion of the finger, a lead pencil, or the like, in opening up the envelop along one edge.

SCREENING APPARATUS.—E. H. NUTTER, Telluride, Col. This apparatus is for use in screening and separating crushed ores, broken stone, ground cement, and similar substances into grades of varying degrees of coarseness. One object of the invention is to provide a movable or a rigid screen, provided with means for forcing impulsive air currents or currents of other gases than air against the screen.

CRATE.—F. L. MARY, Chehalis, Wash. A purpose here is to provide a crate especially adapted for the shipment of poultry, but it may be used for other purposes, and to so construct the crate that it can be quickly and conveniently folded flat so as to occupy but little room and be locked in folded position, and so that further, the crate can be as quickly set up for use.

LETTER-HOLDER. — H. HEINTZ, Elkton, S. D. The invention is an improvement in devices for tying or binding together bundles of letters or parcels of any kind and has for an object to provide a simple construction which may be readily utilized for securing bundles or letters or other parcels varying in size.

HAND-STAMP.—T. J. ROBISON, Curwensville, Pa. The purpose of this improvement is to provide novel details of construction for a hand stamp, which adapt it for special service for stamping dates or other printed matter in books used by beneficial societies, wherein weekly accounts are kept, and that is also available for general use as a dating stamp.

PEN-SUPPORT.—H. PRIESTER, New York, N. Y. This attachment is adapted to be secured to fountain pens or the like, and comprises supporting means so designed as to be readily folded to a position adjacent the pen body while the latter is carried in a pocket or is being used, or to be moved to a position at an angle to the general direction of the pen body to support the body with the pen point above and out of engagement with the table, book, or other surface.

SCHOOL DESK AND SEAT.—J. E. AMENT, Indiana, Pa. A purpose in this invention is to provide a combined school seat and desk, of such construction that the seat together with its back can be raised or lowered without in any manner interfering with the desk back of it and coupled to it.

GROUND-ANCHOR FOR POSTS OR POLES. —E. R. HOBBS, Buhl, Idaho. The construction for a ground anchor affords an inexpensive device that may be readily buried in the ground and caused to automatically distend the flukes thereof as it is forced downward, thus inserting the plate-like flukes into the solid earth laterally, and effecting a very reliable, secure engagement of the anchor therewith.

BOTTLE-STOPPER.—E. H. SPEECE, Beatty, Nev. In use when the stopper is placed a spherical elevation engages the inner surface of the neck and the neck portion of the stopper closely encircles the neck of the bottle, the annular shoulders being received in depressions that maintain the stopper in position. To remove the stopper it is grasped at the upper part and drawn upwardly. This pressure tends to loosen the edges of the stopper neck and also the spherical elevation from the interior of the neck.

LOOSE-LEAF BINDER.—F. H. CRUMP, Los Angeles, Cal. The device readily binds together loose leaves, so that one or more can be readily removed without disturbing the rest, and also for temporarily binding books, periodicals, magazines, etc. The aim is to provide simple, cheap, and efficient means for securely binding the articles named.

DRIVING-HEAD.—F. P. FREEMAN, Dominion, Yukon, Canada. The head is particularly for employment in pipes in mining operations and driven into the ground to admit steam for thawing earth, gravel, and the like, the object being to provide a head that may be removably and adjustably placed on a pipe and that when in position will rigidly engage the pipe during the driving.

Hardware.

BENCH-DOG.—C. H. KROGH, Lincoln, Neb. In practice the groove in the bench is designed to be made of sufficient depth to receive the carrier so that only the dog will project above the face of the bench when the operating device is lowered to set the dog in engagement with the work.

LINK CONNECTION.—A. C. DOWSE, Taylor, Pa. In this patent the invention is an improvement in link connections adapted for use in any relation where a secure but easily detached line, chain, or such other device, is desired, such for example, as in harness, vehicles, on shipboard, etc.

Heating and Lighting.

GAS-VALVE.—A. JARMOLOWSKY, New York, N. Y. In this instance the invention refers to gas valves adapted to be used with fixtures having a plurality of branches, each provided with an individual burner, and has for its object to provide means for turning on or off a predetermined number of burners by a single operation.

Household Utilities.

STOOL.—C. A. BURNS, New York, N. Y. Each leg of the stool is provided with a succession of blocks hinged thereto and to each other, each block having projecting portions at opposite ends fitting into counterpart portions of adjacent blocks, and a seat adapted to rest directly on the legs or rest on the corresponding blocks of the legs. The improvement is more especially designed for piano stools.

WINDOW.—S. U. BARR, New York, N. Y. The object of the present invention is to provide a window, completely dustproof and air tight, and arranged to permit easy opening and closing of the sashes without danger of sticking, and to allow convenient removal of a sash for repairs or other purposes and without requiring detachment of the pane or other parts of the sash. It relates to windows, such as described in Letters Patent of the United States, formerly granted to Mr. Barr.

FRESH-AIR INLET.—J. L. FRUIN and J. J. CROTTY, New York, N. Y. The improvement relates to means for supplying a constant inflow of fresh air, from the street, through pipes and fittings of a plumbing system combined with means preventing the expulsion at such fresh air intake of foul air and gas due to pressure created by periodic waste discharges through the system.

Machines and Mechanical Devices.

HANDLE-LATHE HEAD.—O. W. STITH, Ada, Ohio. A cutter works with the timber grain without gouging it, and prevents tearing out the grain. A roughing bit knocks off the corners of the square blanks fed into the machine and a reducing bit takes the rounded material and reduces it to the largest diameter of handle to be turned. A sliding collar controls the operation of the finishing bit to better suit the reception of end thrusts of the square blank fed to the machine, and whereby it takes up wear, and gives a rigid yet speedy and free control to the finishing bit.

CAN CAPPING AND COMPRESSING MACHINE.—H. L. GUENTHER, Ilwaco, Wash. The invention relates to machines such as shown and described in Letters Patent of the United States, formerly granted to Mr. Guenther. The present invention provides a machine wholly automatic in operation, and arranged for capping and compressing the heads on can bodies and double-seaming the flanges to render the can perfectly air-tight, without the use of solder or other fastening means, packings or the like, to permit use of can in packing food products. This inventor has patented another can capping and compressing machine such as shown and described in the former Letters Patent of the United States first mentioned. The object is to provide a machine, arranged to automatically place a can head in position on the can body, to crimp and compress the flanges of the can body and head, with a view to form an air-tight double seam without use of solder, packings or the like, thus rendering the can exceedingly serviceable for packing food products.

LATHE-DOG. — J. MCCARTHY, Plainfield, N. J. The object of the inventor is to produce a lathe dog capable of the ordinary uses of this tool, but which will have such a construction as will enable it to be used as a tool holder in performing certain lathe operations. An arrangement is provided that will operate to feed the tool automatically to the work.

PLATING-APPARATUS. — C. G. BACKUS, New York, N. Y. The invention relates to apparatus used for electroplating articles and materials in large quantities. One object is to enable the plating operation to be continuous in the sense that charges of such articles may be added from time to time while the mechanism is in motion, the finished charges being removed as rapidly as the plating is completed. Another, is to render the apparatus automatic in its action, and especially to enable the charges to be removed without special attention of the operator and after they have been exposed to electrolytic action an adequate length of time.

SHUTTLE-MACHINE EMBROIDERY-FRAME.—H. HOCHREUTENER, West Hoboken, N. J. A purpose in this case is to provide a frame that will accommodate a long piece of fabric or one or a number of shorter pieces, and to provide means whereby the changes in the frame necessary to accommodate different lengths of fabric may be simply and expeditiously made.

ADVERTISING APPARATUS.—W. J. SAWYER, The Gables, Wembley, Middlesex, England. The invention relates to apparatus for the display of advertisements and the like in the form more particularly of transparencies artificially illuminated, the principal object being to provide means whereby a series of advertisements may be exhibited automatically in succession within the same space.

HEMP-BRAKE.—F. O'NEILL, JR., Paris, Ky. The improvement relates to machines for separating the fiber from the hemp, flax, sea grass, and the like, its principal object being to provide an efficient apparatus of this character. The hemp brake is entirely automatic in its action, and there is no danger in its use of tangling or injuring the fiber and choking is positively prevented.

MACHINE FOR GATHERING COTTON-SQUARES.—K. S. BUNTING, Moulton, Tex. The machine is driven through the field with the mouths of the branches of the supply pipe adjacent to the ground. The movement of the machine puts the fan in motion, creating a draft through the pipe, which picks up the punctured squares, and the current of air passes them through the fan casing and into the perforated container, from which the air escapes. The squares are forced out between the rolls, which press and kill the eggs and insects.

ABRADING-MACHINE. — A. V. WALKER, Leominster, Mass. The object in this case is to provide a machine by means of which curved surfaces of wood-work and the like can be rendered smooth, or finished, rapidly and easily, and which is adapted for the application of the abrasive work presenting different curved surfaces.

MOLDING-MACHINE.—T. H. KELLER and J. A. HAAS, Lancaster; H. B. KELLER, Philadelphia, and J. H. KELLER, Lititz, Pa. This invention relates to bread-making machinery, and its object is to provide a shaping or molding machine designed to give a desired predetermined shape to a lump of dough or a like material and arranged to render the material homogeneous by pressing out any air or gases contained in the material, then forming it into shape and maintaining the same during the subsequent rising and baking process, to prevent the finished loaf or roll from breaking or cracking, and to provide the lump with a smooth exterior surface. This result is obtained by the provision of rolling devices for rolling a sheet of dough into a roll, one of the devices rolling the sheet in one direction and the other subsequently rolling the sheet in the opposite direction, to unroll the twist given to the sheet by the first rolling device.

WASHING-MACHINE.—E. EISEMANN, New York, N. Y. The inventor contemplates a machine embodying an endless belt movable within a tank containing the wash water and having means for squeezing out the feathers applied to the belt as they repeatedly pass through the tank, together with means for rubbing the feathers transversely to the movement of the belt.

BRICK-HANDLING MACHINE. — W. H. FRANCIS, Cherryvale, and C. FRANCIS, Independence, Kan. In a former patent granted to Mr. W. H. Francis for a brick-handling machine, the machine handled bricks in bulk, whereby a pile of bricks, stacked up in accordance with a pre-arranged order may be picked up in bulk and transported to another point without breaking bulk. The present invention comprises novel means for doing this same work.

WATER FLUSHING DEVICE. — G. H. HOLMES, New York, N. Y. One of the purposes here is to provide a portable device for flushing streets, so constructed that the hose is carried beneath a wheel-supported platform with the nozzle close to the ground at the forward end, and to provide means whereby the nozzle can be given a sweeping horizontal movement upon the arc of a circle to throw water over the greatest possible area, and also a rocking movement in a vertical direction to elevate or depress the nozzle.

Prime Movers and Their Accessories.

ENGINE.—J. WEISENBORN, Quincy, Ill. The invention has reference primarily to internal combustion engines of the two-cycle type, and has in view the provision of an engine construction by which perfect lubrication of all working parts is effected. During the running of this engine, lubrication may be continued, a small quantity of lubricant passing into the circumferential groove at each complete stroke of the piston.

COUNTER.—F. C. HOWE, Globe, Arizona Territory. The invention pertains more particularly to counters used for ascertaining the piston strokes made by steam or explosive engines, pumps and the like. An object is to provide an efficient counter by means of which the total number of strokes made by a piston can be determined, and by means of which the number of power strokes can likewise be ascertained.

TWO-CYCLE INTERNAL-COMBUSTION ENGINE.—H. S. HART, Madison, Wis. One object of this inventor is to provide means, whereby a fuel charge is compressed by the piston of each engine, and whereby the charge is delivered to the working chamber of the next successive cylinder of the series. It is very much lighter in weight than the engine of the same horse-power constructed along customary lines, the reduction in weight being largely due to the elimination of the fly wheel and all valves, springs, levers, and gears for controlling the operation.

Railways and Their Accessories.

RUNNING-SWITCH AND GUIDE.—T. J. DRIVER, Holualoa, Hawaii. The improvement refers to elevated railways for the transportation of field products, merchandise and the like. The switch and guide is arranged to permit an uninterrupted transportation over a circuitous route, thus avoiding undesirable rehandling of merchandise at the point of divergence in the route, and thereby reducing the cost of operation to a minimum.

RAILWAY SIGNAL SYSTEM.—A. WILHELM, St. Johns, Ore. In this patent the invention relates to railway signal systems, the more particular object being to provide for effectively signaling trains in a predetermined relation according to the condition of the track, the signal being controlled by movements of the train and partially by will of an operator.

Pertaining to Recreation.

DRUM.—A. D. CONVERSE, Winchendon, Mass. The purpose of the invention is to provide a construction of toy drum wherein the body constitutes a portion of the hoops and serves as a direct support for the heads, the hoops being offset from the outer face of the body and made hollow of sheet material but having the appearance of being solid.

HOLDER FOR FISHING-TACKLE.—M. M. SCHANEY, Dubois, Pa. The holder is for use for artificial flies whereby they are held securely and without pressure or injury, but may be easily and quickly detached, also a compartment for leaders and moistening pads, and compartments and supports for snelled hooks, minnow hooks or gangs, trolling spoon, and artificial minnows.

Pertaining to Vehicles.

DRIVING MECHANISM FOR MOTOR-VEHICLES.—W. H. DOUGLAS, Belleville, N. J. This mechanism for motor vehicles is arranged to drive traction wheels independently from different motors, to allow yielding of the vehicle body relative to either traction wheel, without disturbing or affecting the independent driving mechanisms of the traction wheels.

BRAKE FOR VEHICLES.—J. G. WELLER, Munhall, Pa. The invention relates to brakes such as used on vehicles, and the object of the invention is to produce a simple mechanism for removably attaching a brake block or rubbing face to the brake shoe. The use of nails or similar fastening devices which destroy the shoe and increase the wear on the tire is avoided.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(10799) H. Z. L. says: Which of the pairs of wheels, inner or outer, leaves the ground when an automobile turns a sharp corner at high speed, under these conditions: (1) Road level, (2) machine evenly balanced on both sides, (3) corner sharp enough to raise one pair of wheels. This question came up in class, and as I said that the inner wheels left the ground, if any, I was laughed at by the rest of the class, including the professor. I come to the highest court of appeal, so as to avoid all misunderstandings. A. In the case stated by you of an automobile rounding a curve on a smooth level road, provided the wheels could not skid sideways (which is what generally happens) the machine would be tilted upward on the base of the outer wheels as a fulcrum, thus lifting the inner wheels from the ground. This would happen because centrifugal force acts on the center of gravity of the machine to project it horizontally outward, which it cannot do, as we have presupposed that the wheels cannot skid. Therefore, it must swing the center of gravity about the base of either the inner or outer wheels as a fulcrum. Since the center of gravity of the machine is above the base line of the wheels, and since centrifugal force tends to project it *outward,* it is impossible for said center of gravity to move about the base of the inner wheels as a fulcrum without causing the outer wheels to sink into the ground. Consequently, the base of the outer wheels must act as a fulcrum and the inner wheels be raised in the air, as there is nothing but the force of gravity to prevent them from so doing. In the case of a suspended car, the reverse is true, as there the center of gravity would be below the base line of the wheels, and it could not move centrifugally around the base of the outer wheels as a fulcrum without causing the inner wheels to sink into the track. Consequently, it would have to move about the base of the inner wheels as a fulcrum, and the outer wheels would be raised.

(10800) J. V. asks: Will you kindly inform me in Notes and Queries when it is sunrise? Is it when the disk of the sun is first seen above the horizon or when the entire disk is above the horizon? The same would apply also as to the setting of the sun. A. The times of sunrise as given in ordinary almanacs are the local mean times when the upper edge or limb of the true sun, as corrected for refraction, is in contact with the sensible horizon of the place, or of any place of equal latitude. This is Todd's definition as given in his "New Astronomy," a valuable book which we can send for $2.

(10801) V. E. M. asks: 1. Two cars start from a power-house on an electric road, the last car using 1-3 of the power; how does the current get to the car ahead after some of it passes through the motor of the first car? Please explain in full. A. The E. M. F. of the trolley feeders is sufficient to provide current for all the cars which will be on a section of the line at one time. Feeders run from the bus bars of the station to the beginnings of the sections of the line, and each feeder enters and supplies current to its own section. If the motors require 500 volts the E. M. F. at the dynamo will be perhaps 10 per cent above that, or 550 volts, to allow for the drop of the line. A booster may be used to keep the pressure at the remote ends of the lines up to the necessary point. As to the particular point about which you ask, how a car ahead gets current when a car behind it is taking current also, there is no difficulty in understanding this if you understand how a house further along the street can get water while you are drawing water in your house from the same main in the street. The main is large enough to supply all the houses which are connected to it, and so is the feeder for a particular section of a trolley line. 2. What is the method of making an Edison Lalande cell (fluid battery)? A. The negative plate of the Edison primary battery is made from copper oxide prepared by compressing it. It cannot be made without heavy presses. The other parts of the cell have no particular method of manufacture, different from making other zinc plates by casting them. The caustic potash is the potash of commerce.

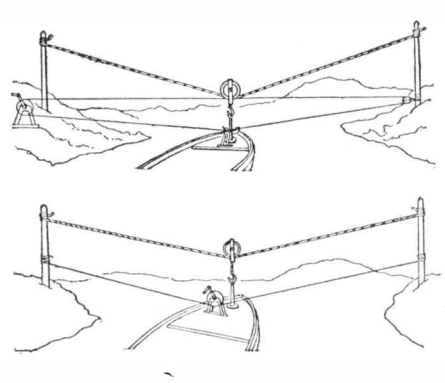
(10802) W. T. J. asks: A person would sit on a chair and two people stand on either side. Then they would all take three deep breaths simultaneously. At the third breath the persons on the sides placed two fingers under the knees and arms of the one in the chair, and while inhaling raised the one in the chair fully five feet off the floor without any effort whatever. This was done to half a dozen different people, and as some of these weighed 150 pounds, it seems impossible to account for it. A. We have stated our view of the feat of lifting a person while inhaling breath or otherwise preoccupied, in answer to Query 8856 in Vol. 88, No. 9, to which we would refer you. As the writer used to lift more than 100 pounds with his little finger when a boy, he does not think it an impossible feat to lift 75 pounds with two fingers of each hand, as is required if two persons lift a man weighing 150 pounds in the manner you describe. The four girls who lift a lady weighing nearly 200 pounds only lift 50 pounds each, and this again is not a very heavy weight for a girl to lift. The preoccupation of the mind by breathing in unison and the intentness upon the effort of lifting at the same instant as the rest enable one to do much more than if not so preoccupied.

(10803) J. E. G. asks: If ⅛ cubic inch of rifle powder were confined in a chamber of 1 cubic inch square and ignited, what would the pressure be on each of its six sides? Would the pressure remain any length of time? A. It is impossible to estimate the pressure which would be produced in a rifle chamber if ⅛ of a cubic inch of powder were ignited in a confined space of a cubic inch. A certain quantity of gas would be generated, but the pressure of this gas would depend upon its temperature, and the maximum temperature which is attained in such circumstances depends on the rate of combustion and the character of the chamber in which it is confined; so that it is impossible to form any accurate estimate of it. If the chamber were airtight, the pressure would gradually decrease as the liberated gas cooled. After it was cooled to the temperature of surrounding objects, the temperature would remain constant, and the pressure of the confined gas would then remain constant. It is roughly estimated that gunpowder when burned expands to 2,600 times its original volume. Assuming this figure, the pressure in the problem you give would be about 325 atmospheres, or approximately 4,800 pounds per square inch.

(10804) C. H. asks: 1. I have a quantity of No. 16 copper wire in pieces of from 2 to 3 feet in length; would it do to wind the armatures and field magnet described in SCIENTIFIC AMERICAN SUPPLEMENT No. 641, if the joints were soldered and wrapped with tape? A. If a good soldered joint is made you can wrap it in tape and use a wire in winding a field or armature. These joints will however, be larger than the single wire and will, if there are many of them, cause the winding to be more or less irregular, and unsightly. A neat job cannot be made with splices in the wire. 2. Why is the sodium salt better than the potassium salt for use in a bichromate cell? A. Sodium bichromate is easily dissolved in water, cold or hot. Potassium bichromate requires hot water to dissolve it to sufficient strength for battery use. When sulphuric acid is added to the potassium bichromate solution an alum crystallizes out upon cooling, and crystals are liable to form in the cell also. Neither of these things occurs with the sodium salt. Chromic acid is now to be procured from dealers in chemicals and is to be preferred to either of the bichromates.

(10805) C. L. V. asks: Please explain in your Notes and Queries column why a distinct shock is felt when a piece of metal is passed you by another person, in a house which is wired for electric lights. I have noticed this a number of times in this house, but never in any other. A. An electric charge is easily generated in cold, dry weather by walking along a woolen carpet, especially if one scuffs the feet a little on the carpet as he walks. In this way one may light the gas without a match by presenting the tip of a finger to the gas jet. A spark will pass from the finger to the tip of the burner, and a slight shock may be felt. It is obvious that the same shock may be given to another, by reaching out the hand to him. A piece of metal is not needed, nor is it necessary that the house should have electric lights in it. It can be done anywhere in the cold regions, in the cold season.

(10806) C. M. F. writes: We wish to build a ferryboat for crossing a slow-running (fresh) stream, the Bolf River near here, and wish your charges, if any, for either a plan or specification which will enable us to build it so that it can operate easily and be durable and substantial. We plan to pull it across by means of a slack No. 10 iron wire. The distance across is about 100 yards. This is a hardwood country with plenty of oak and gum at our hand. It must be about 18 or 20 feet long and carry 5,000 pounds (a team and load). A. We would suggest your hauling the boat across the river by one of the arrangements shown in the sketches. Have the boat supported (i. e, kept from going down stream) by means of a traveling block attached to the boat running on a



fixed cable fast to posts in the banks, and haul with an independent cable, either single, fast to posts in the banks and with two or three turns passed around the drum of a slow hand-power winch on the boat, or double (endless) running through a pulley on one bank and around the drum of a winch on the other, the bight being kept fast to the boat. The operator could travel with the boat with the former arrangement, or remain on the bank with the latter, whichever was more convenient. For plans and directions for building such a pontoon as you require, we should recommend our SUPPLEMENT No. 25, of which the scow plans could be easily modified as regards dimensions for the size of pontoon you require.

(10807) I. M. K. says: Will you please tell me the difference between what is called loadstone and magnetic iron ore? A. Lodestone is magnetic iron ore which has the property of coming to rest pointing north and south, as the magnetic needle points, and thus guiding the voyager or traveler on his way. It is not spelled *load,* to carry, but *lode,* to lead or guide. All magnetic iron ore is not magnetic, but all lodestone is magnetic iron ore; that is, much magnetic iron ore is not magnetized.

(10808) R. T. D. asks: In the March 21 number of the SCIENTIFIC AMERICAN, query 10687, W. S. asks for a cheap non-conductor of heat. The answer is a vacuum. 1. Would that apply to a refrigerator or ice cream cabinet? And does it mean just a dead air space? A. While a vacuum is the most perfect non-conductor of heat, it can hardly be called a practical method of insulating a refrigerator. A dead air space filled with sawdust, with wood for the outside covering, is far preferable, since the wood is itself a non-conductor of heat and the sawdust prevents currents of air in the space between the outer and inner walls of the box. For small refrigerators a metal box is ordinarily used on the inside, because metal will not absorb water and odors and can be cleaned easily. 2. Is there any way of keeping pipes carrying cold brine from getting frosty and sweating? Have covered them with paper and cloth, then painted them with plaster of Paris, and over that a coat of mineral paint. But they still sweat. Would paraffine wax or water glass be of any use? If so, how to apply? A. You cannot prevent pipes from sweating. The moisture comes from the air of the room in which the pipes are, and not from the pipes. It is condensed on the pipes because they are colder than the air of the room, just as dew forms on the grass in the evening. 3. Is there any cheap way of recovering salt from brine? A. Salt may be recovered from brine by allowing the brine to evaporate in the air. This will cost nothing.

(10809) I. L. C. says: Will you briefly explain to me how ordinary series street arc lamps are tested to determine their candle power? Or tell me where I will find detailed instruction in this matter? A. The candle-power of an arc lamp may be measured in various ways with widely different results. The mean horizontal candle-power is the average of all horizontal measurements. The mean hemispherical candle power is measured at all directions and angles below the horizontal, thus giving the mean value of the light sent down from the lamp. The mean spherical candle-power is the average of measurements at all angles above and below. It is therefore the average candle-power in all directions. The maximum candle-power is the greatest candle-power found in any direction, usually 40 deg. below the horizontal. The nominal candle is an arbitrary rating. A lamp using 450 watts gives 2,000 candles, and one using 300 watts gives 1,200 candles. We can supply you with Stine's "Photometric Measurements," with especial reference to arc and incandescent lamps, price $1.75 by mail.

(10810) J. L. says: I have an electric light outfit which I made, using a knife switch, a fuse block for two fuses, then an arc light, using for a carbon plain battery carbons, fixed so that I can move the points together and apart, and a lamp socket using a sixteen C. P. lamp. 1. In throwing in the switch, the arc lamp will burn bright for a few seconds and then burn out one of the fuse plugs; there is no short circuit anywhere, so what do I need—a rheostat or what? A. The trouble with your arrangements for the arc light is that the carbons constitute a short circuit on the line, and blow the fuse. An open arc light requires 50 volts. Any more than this must be disposed of by a rheostat or other device. If the line voltage is 110, you will need about 5.5 ohms of No. 12 wire, iron or German silver. 2. What is a Leyden jar? Will it supply power for one of these lamps, and how do you make one? A. A Leyden jar is a glass jar coated with tinfoil inside and out a little more than half way from the bottom to the top. It does not generate electricity and cannot light a lamp.

(10811) O. S. D. says: In your note and query department of May 9, under Query 10748, information was asked regarding the fact that a little fat, butter, cream, or anything of that kind dropped into a kettle of boiling maple syrup would prevent its boiling over, and the answer was that the effect of the grease was the same as the effect of oil on water, which prevented the breaking of the waves. I do not believe the party who answered this inquiry ever saw the phenomenon. When the syrup boils up it boils large bubbles, which will very quickly rise to the top of the kettle and run over, but as quickly as the grease touches the surface these bubbles immediately break up, and instead of the large bubbles that appear before there are a large number of very small bubbles which break quickly and do not rise. My understanding is that the small amount of grease serves to weaken the film of the bubble and make it break quickly, practically the opposite of your answer. Will you look this matter up further? A. We regret to be obliged to shake your belief that the writer of the note upon the use of oil in boiling maple syrup had never seen the phenomenon described, but the fact is that he did the trick more than fifty years ago. Many times he stood over the kettle and kept down the bubbles. He did not understand it then. He is quite sure that he does now. There is no doubt whatever that your statement is correct that the oil weakens the film of the syrup and thus permits the steam from the water to pass off more readily. The superficial viscosity of a 30 per cent solution of sugar is in c. g. s. units 3.067, while that of lard oil is only 0.146. The figure for water is 0.01, although that is hardly involved here. The action of oil in preventing the breaking of waves is due to its increase of surface viscosity; in the prevention of foaming its effect is produced by the reduction of surface viscosity. The effect is the same, the mode of producing that effect is different.

(10812) R. S. asks: I am interested in lightning rods, and should be glad to have you give me what information you can in regard to same, and also answer the following: Would a ½-inch seven-strand galvanized iron cable hold right if well grounded? How far above the roof should the points be? Would it be all right if at the end the wires were separated and sharpened to a point, and if so, would it be necessary to have such points plated, and if so, with what? Could I get a good ground by driving into the ground an inch galvanized iron pipe and running the cable into same? If so, to what depth should pipe go? Is a metal roof any protection? A. A ½-inch seven-strand galvanized iron wire cable will make an excellent lightning rod. It will serve also as points, carrying the ends a foot or so above the roof at corners and gables. Put a bow over the chimney tops, perhaps two bows across diagonally. Since the acids of the smoke will rapidly corrode the metal, it will be necessary to replace the corroded parts frequently. Fasten all parts firmly to the building. A good ground may be made through a driven pipe, if the lower end of the pipe reaches a permanently wet stratum or ends in water. A metal roof will form a good protection from lightning if connected to a good earth at the lower corners by good rods or wire cables, as you propose. The Department of Agriculture issues reliable instructions for protecting buildings from lightning.

(10813) G. B. says: Which wheels of an automobile leave the ground when turning a corner and going at a fast pace—the inside or outside ones? A. The wheel on the inner side of a curve leaves the ground when the vehicle goes around too fast. The automobile proper turns over outward.

(10814) J. O. says: Please let me know through your columns or otherwise what is *electrochimie,* and what can be produced by it? A. "Electrochimie" is the French word for electrochemistry. It is a branch of chemical science embracing the processes of chemical manufacturing in which electricity is the force employed to bring about the reactions. Arrhenius's "Text Book of Electrochemistry," price $3.25, is an authority on the theory of the subject, and Blount's "Practical Electrochemistry," price $3.25, is a reliable guide. We can supply both works at the prices named.

NEW BOOKS, ETC.

THE INSECT BOOK. By W. Percival Westell, F.L.S., M.B.O.U. Illustrated with photographs by R. B. Imisson. London: John Lane, The Bodley Head. New York: John Lane Company. 16mo.; cloth; 120 pages. Price, $1.

That practical series, The Country Handbooks, is extended by this charming brochure. Without being a complete treatise the book is helpful as far as it goes. The photogravures add much to its value. The entertaining text should induce sufficient interest to make the reader pursue the studies even beyond the limits presented. Thirty-six photographs illustrate the contents and we hardly can see how any process outside of that of colors could have been so well chosen for obtaining such crisp yet delicate results. The insect life portrayed of the garden, of the waterside, of the woodland, of meadows, heaths, lanes, and households relates to British species, and is described by one of the best of entomological writers. The index is ample.

PARADOXES OF NATURE AND SCIENCE. Things Which Appear to Contradict General Experience or Scientific Principles. With Popular Explanations of the How and Why. By W. Hampson, M.A. Oxon., L.S.A. New York: E. P. Dutton & Co., 1908. 8vo.; pp. 304. Price, $1.50.

Mr. Hampson has published a very interesting and readable book on the tricks which nature sometimes plays us. The volume is divided into four parts. In the first such mechanical paradoxes are discussed as a carriage which on level ground is more easily drawn loaded than empty; throwing balls around a corner; and solids defying gravity. In the second part, devoted to paradoxes of the physical state, Mr. Hampson explains how ice is cut without severing the parts and how it may be melted without heat or cold; how water may be boiled by cold instead of by fire or flame; a vessel too hot to boil water; freezing produced by boiling; and the perpetual motion fallacies. The third part, on chemical paradoxes, explains how fire may be a source of water and water a source of fire, among other interesting phenomena. Among the physiological paradoxes constituting the fourth part are discussed certain peculiarities of vision and hearing as well as of bodily structure. The explanation of the problem of Achilles and the tortoise seems rather labored. It might have been somewhat more simply explained in the usual algebraic way rather than by the philosophical method of non-continuity of space upon which the author relies. For all that the book is interesting and instructive.

MINES AND MINERALS OF THE BRITISH EMPIRE. Being a Description of the Historical, Physical, and Industrial Features of the Principal Centers of Mineral Production in the British Dominions Beyond the Seas. By Ralph S. G. Stokes, late Mining Editor Rand Daily Mail, Johannesburg, S. A. London: Edward Arnold, 1908. 8vo.; cloth; 403 pages. Illustrated. Price, $4.20.

The author deals in an intimate and not over-technical manner with material industrial features of various producing sections, and gives distinctive marks of ore occurrence and methods of exploitation with excellent descriptive force. The work is not a guide to investment, but those interested in the practice and science of mining metallic and non-metallic minerals, will find the subjects of gold, silver, tin, copper, lead, pig-iron, steel, plumbago, diamonds, etc., described thoroughly and comprehensively. The author has written with equal clearness on the labor, methods, and geological and industrial conditions of the various mineral industries. The chapter contents and a copious index are well adapted for facilitating the reader's progress. The illustrations are numerous and clearly represent the actual life, operation, and machinery of mines in South Africa, Ceylon, India, Burma, Malay Peninsula, Australia, New Zealand, and Canada.

THE AMERICAN PRACTICE OF GAS PIPING AND GAS LIGHTING IN BUILDINGS. By William Paul Gerhard, C. E., Consulting Engineer for Hydraulic and Sanitary Works, Etc. New York: McGraw Publishing Company, 1908. 8vo.; cloth; 306 pages. Price, $3 net.

This book is an addition to the author's valuable list of works on plumbing and house drainage. Leaving out the treatment of the numerous processes of production and distribution of illuminating gas and the lighting of streets, alleys, and public areas, he practically enters into the subject where installation and utilization reaches the consumers' premises. Before expounding how gas fitting should be done for interior work, a foregleam of the breadth of quality of the volume may be had in the attack through the first two chapters on prejudices against and popular fallacies about gas. The parts devoted to extra technical matter, such as specifications, rules, tables, regulations, and tests, are written in a style that prevents the need of the lighter chapters as resting islands, those for instance, on the advantages of and the arrangements for the use of gas for light, heat, and power; practical hints for consumers; lighting of country houses; discussions of hygiene, meter stories, accidents, dangers, and historical development. A large index and a remarkable bibliography on gas lighting are furnished. Included in the latter are the titles of English, American, German, and French books, pamphlets, reports and articles and various articles on gas, by Mr. Gerhard.

THE ROMANCE OF THE REAPER. By Herbert N. Casson, author of "The Romance of Steel." New York: Doubleday, Page & Co., 1908. 12mo.; cloth; 184 pages. Illustrated. Price, $1 net.

The author in spite of the title and the pet word "magical" as applied to mechanism, has given a comprehensive history of the very practical reaper. The debt the world owes to McCormick and the useful inventors and business men who have developed the grain machine industry is summed up in this little work, and fractional waymarks of the story are pointed out in chapters full of research in invention, harvestry, biography, and statistics. The last are not tabulated and this fact helps to make the book appear without a dry page to the average reader, adult or youth. The illustrations are good and of the broadest territorial range as the reapers, binders, etc., are seen at work in all the continents. Sixteen portraits are presented of those eminent in the business of having made all that the farmer demands in advancing from muscle to machinery in the cultivation of the soil. The title page bears an error in the publishing firm's name.

QUESTIONS AND ANSWERS IN ELECTRICAL ENGINEERING. Being a Compilation of the Questions Set by the City and Guilds of London Institute in the Preliminary Grade of Electric Lighting, from 1899 to 1907 inclusive, with Solutions to all Questions. By A. E. Moore, A.M.I.E.E., and Frank Shaw. London: Longmans, Green & Co. New York, Bombay, and Calcutta, 1908. 12mo.; cloth; 151 pages. Price, 90 cents.

This small work is a valuable addition to the select list of books on electricity and magnetism published by Longmans, Green & Co. It is an excellent example of the question and answer form of preparing students for examinations. In this case it is intended for those who, while understanding the subject matter of the questions, are deficient in expressing themselves. An admirable line of accommodation of the answers to a more extended use, lies in the fact that the solutions are amplified, but in such a manner that they can be adapted to the purposes of a purely elementary examination. The solved problems are fully illustrated by diagrams, and one of the features of the questions section is that on practical wiring.

ASTRONOMY WITH THE NAKED EYE. A New Geography of the Heavens. With Descriptions and Charts of the Constellations, Stars and Planets. By Garrett P. Serviss, Author of "Astronomy with an Opera Glass." New York and London: Harper & Brothers, 1908. 12mo.; cloth; 247 pages. Price, $1.40 net.

This issue is at a time when astronomy under the advantages of scientific instruments and institutions of learning is increasingly neglected. In the common schools, even the constellations are not taught, and the author shows that the few mathematical formulas in the best seats of learning, are studied only to be soon forgotten. If the higher means at hand are regarded so lightly, his work on Astronomy without artificial aid to the eye may be welcome, as it is well planned to show the scheme of the constellations in a way to make the subject become popular. The purpose of the author is to recall the busy to that branch of astronomy which is within easy reach. Fourteen charts are used, and every month is constellated on a double page plate with the outlines of the symbols and their names in color. All clusters and their features are beautifully shown and the orderly march of the stars can be clearly followed through the year. Constellations with two or three exceptions are formal only on the maps, but studying them on a chart is necessary to enable the amateur to relatively associate the celestial bodies easily and definitely in the heavens. The last four chapters are given to the Southern Constellations, the Zodiacal Light, the Milky Way, and the Moon.

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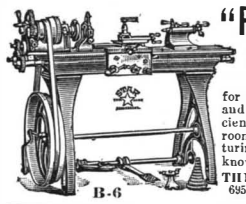

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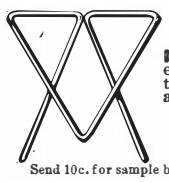

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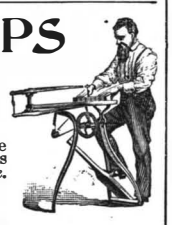

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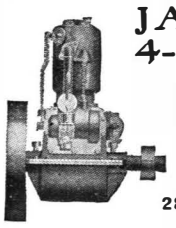

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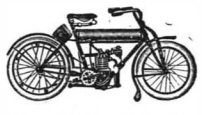

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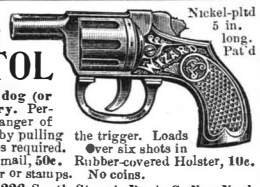

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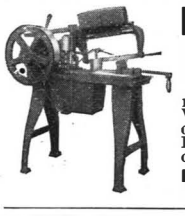

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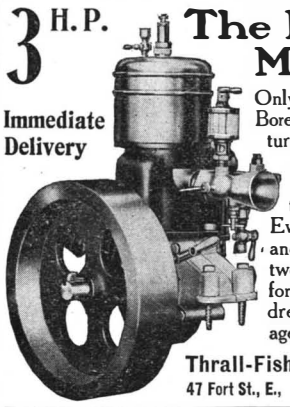

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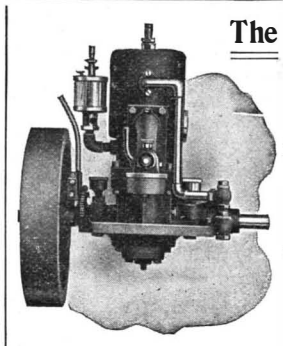

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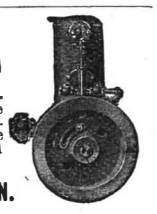

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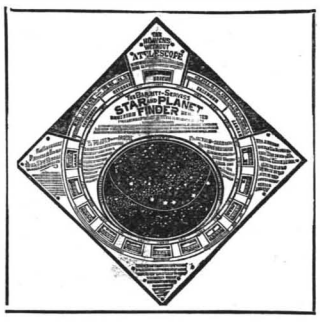

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Inquiry No. 8661.—Wanted to buy machinery for making cutlery.

Inquiry No. 8662.—Wanted to buy small machine for drawing thread from cotton and machine for making lozenges.

Inquiry No. 8663.—Wanted to buy file cutting machines.

Inquiry No. 8666.—Wanted to buy screw making machinery.

Inquiry No. 8667.—Wanted to buy needle, pin and pen machinery.

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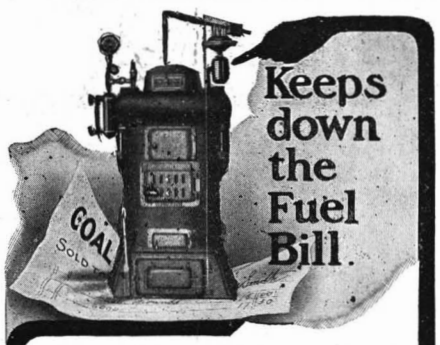

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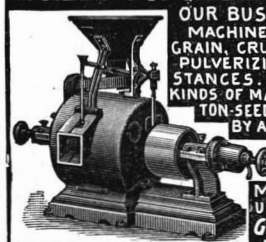

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Hats, men's and boys', Wallerstein Brothers. 69,654
Heating apparatus, certain, J. F. Grosswiller. 69,608
Hoods, motoring, M. Munson 69,649
Inhalants, Sharp & Dohme 69,567
Insulators, electric, Albert & J. M. Anderson Manufacturing Co. 69,643
Jewelry, certain, Schanbacher & Brod 69,650
Kummel, J. A. Gilka 69,627
Leathers for manufacturing purposes, Pfister & Vogel Leather Co. 69,576, 69,577
Lotion, complexion, L. C. Rickles 69,594
Lotions, skin and scalp, A. E. Williams 69,600
Machines, certain, Filter & Brautechnische Maschinen-Fabrik Actien-Gesellschaft, vorm. L. A. Enzinger 69,617
Mackerel and herrings, Strohmeyer & Arpe Co. 69,596
Malt, Charles Zoller Co. 69,581
Meats, cured, Electric Meat Curing Co. 69,583
Medicinal powder, Farbwerke vorm. Meister Lucius & Bruning 69,560
Medicine for certain diseases, Appendixine Co. 69,601
Medicines, aperient and laxative, E. Bischoff. 69,569
Medicines, certain named, J. L. Lascoff 69,632
Milk and cream, H. B. Richards 69,636
Newspaper, daily, Lewis Publishing Co. 69,033
Oil, corn, Corn Products Refining Co. 69,624
Oil for use on roadways and as a dust preventive, Westrumite Company of America 69,639
Oil, polishing, Ilsley & Held Co. 69,572
Paper and envelops, writing, G. B. Hurd & Co. 69,628
Pencils, lead, Eagle Pencil Co. 69,625
Pens and pencils, fountain, L. E. Waterman Co. 69,612
Pianos, interior player, G. P. Bent 69,644
Pills and plasters, H. M. Graves 69,584
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Pretzels, Pfenninger Pretzel and Baking Co.. 69,565
Railways and rolling stock for the same, pleasure, S. E. Jackman ..... 69,609 to 69,611
Remedies for certain diseases, National Herb Co. 69,592
Remedy for certain diseases, A. Nitz 69,563
Remedy for certain diseases, N. C. Polson 69,566
Remedy for certain diseases, S. Woolston 69,621
Remedy for diseases of the eye, Wright's Indian Vegetable Pill Co. 69,579
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Remedy for rheumatism, A. Peter 69,614
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Rubber combs, Hannoversche Gummi-Kamm-Compagnie Actien-Gesellschaft 69,647
Salve or ointment, Meadoline Co. 69,575
Shades, slatted, A. A. Boeck 69,549
Shells, paper shot, Von Lengerke & Detmold. 69,556
Shoes and soles and felt insoles, leather, Thomas G. Plant Co. 69,568
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Soap, W. K. Freeman 69,561
Soaps, Ericka Manufacturing Corporation 69,559
Soaps and washing powder, James Pyle & Sons 69,573
Starch, laundry, Independent Starch Co. 69,587
Stoves and ranges, A. J. Lindemann & Hoverson Co. 69,622
Teas, J. C. Siegfried & Co. 69,595
Thread and yarn, cotton, Spool Cotton Co.. 69,651, 69,652
Toilet preparations, certain, E. Palmer 69,613
Tonic, F. A. Luyties 69,591
Watches, watch cases, and movements, Langendorf Watch Co. 69,553
Waterproof material, certain, Paraffine Paint Co. 69,554
Waters, table, W. T. Wagner's Sons 69,638
Woolen and worsted piece goods, J. S. Ainley 69,642
Woolen piece goods, H. Dickinson 69,645
Worsted dress goods, Fern Rock Woolen Mills 69,656

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"Hattie Hall," for cigars, Wilkowski Bros. 14,254
"Household," for tomato pulp, I. Levin 14,257
"Imperial Caviar," for caviar, N. Pushkareff. 14,258
"James Lindsay," for cigars, L. E. Neuman & Co. 14,253
"Re-pro The Modern American Art Finish," for an art finish, Chicago Wood Finishing Co. 14,261
"Wagner's Celebrated Green Mountain Salve," for a salve, R. W. Ayer 14,259
"Ye Fifth Avenue Milk Chocolate," for milk chocolate, Griffing Chocolate Co. 14,255

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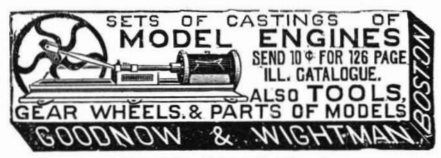
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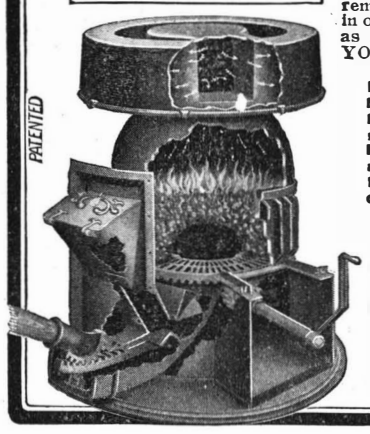

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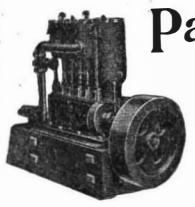

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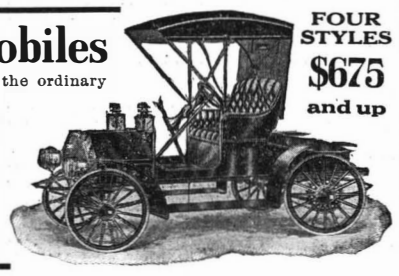

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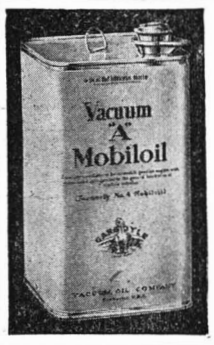

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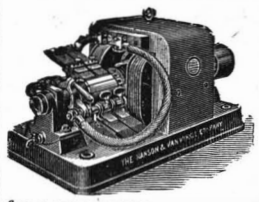

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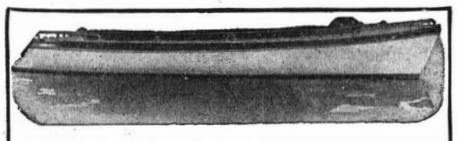

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